SCIENCE 8

MODULE 5

FRESHWATER AND SALTWATER SYSTEMS

Learning Technologies Branch

Alberta LEARNING

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Science 8
Module 5: Freshwater and Saltwater Systems
Student Module Booklet
Learning Technologies Branch
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This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

You may find the following Internet sites useful:

- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
- Learning Resources Centre, **http://www.lrc.learning.gov.ab.ca**

The use of the Internet is optional. Exploring the electronic information superhighway can be educational and entertaining. However, be aware that these computer networks are not censored. Students may unintentionally or purposely find articles on the Internet that may be offensive or inappropriate. As well, the sources of information are not always cited and the content may not be accurate. Therefore, students may wish to confirm facts with a second source.

WELCOME

Contents

Resources

Textbook

To complete the course, you need the textbook *ScienceFocus 8*.

Multimedia

Attached to Module 1 of this course is a CD titled *Science 8 Multimedia*. This CD contains multimedia segments designed to help you better understand particular concepts presented in this course. Ask your teacher or home instructor if you need help using this CD.

Materials and Apparatus

A list of materials and apparatus is given on page 10 of each Student Module Booklet. These items are needed to complete the module. Some of the materials and apparatus may be provided at your local school lab. If you don't have access to a school lab, you will need to get the loan kit. Talk to your teacher for more information.

Before You Begin

Organize your materials and work area before you begin: Student Module Booklet, textbook, notebook, pens, pencils, and so on. Make sure you have a quiet area in which to work, away from distractions.

Because response lines are not provided in the Student Module Booklet, you'll need a looseleaf binder or notebook to respond to questions and complete charts. It's important to keep your lined paper handy as you work through the material and to keep your responses together in a notebook or binder for review purposes later.

Refer to the Planning Ahead page for directions on what you need to do before you start this module.

Good luck!

Icons

This is one of five Student Module Booklets for Science 8. As you progress through this module, you will meet several icons.

Do Ahead

Some preparation must be started well ahead of the activity or investigation. E.g., start the seedlings for the investigation in Lesson 3.

Teacher or Home Instructor

The teacher or home instructor should be contacted for help, approval of some procedure, or checking answers.

Assignment Booklet

Work needs to be done in an Assignment Booklet.

Safety

You must be very careful when you see this symbol.

Textbook

A reference is made to *ScienceFocus 8*, the student textbook for this distance learning course.

Internet

This is a reference to the Internet. **Note:** Any Internet website given is subject to change.

Multimedia

This is a reference to the *Science 8 Multimedia* CD.

Overview

Maybe you help out at home by mowing the lawn. If there's no rain for a week or two or if the lawn isn't watered, you get a break from the lawn mowing. You likely don't mind such a break. But imagine if the lack of rain turns out to be a drought—that's what happened in the summer of 2002. In parts of Alberta and Saskatchewan the drought was the worst in decades—crops failed to grow, livestock had to be slaughtered or sold as their food supply ran out, fire bans were issued in many areas, and communities had restrictions on water use. The drought of 2002 was a reminder of the importance of water—for people, animals, plants, and society.

Section 1
Water on Earth

Section 2
Water Systems

Section 3
Aquatic Ecosystems and Water Quality

In this module you will explore the importance of water. You will examine the powerful, constantly changing nature of aquatic systems—the interaction of landforms, sediments, water, and climate. You will investigate the factors that affect health and the distribution of living things in aquatic systems. You will also investigate factors that affect the quantity and quality of water available for human use.

Assessment

The booklet you are presently reading is the Student Module Booklet. It will show you, step by step, how to advance through Module 5: Freshwater and Saltwater Systems.

This module, Freshwater and Saltwater Systems, has three sections. Within each section, your work is grouped into lessons. Within the lessons, there are readings, investigations, activities, and questions for you to do. By completing these lessons you will discover scientific concepts and skills, develop a positive attitude toward science, and practise or apply what you have learned.

Suggested answers in the Appendix of this Student Module Booklet will provide you with immediate feedback on the answers to questions in the lesson. Your teacher or home instructor will also provide you with feedback on your progress through the module.

At several points in this module you will be directed to an accompanying Assignment Booklet. Your grading in this module is based on the assignments you submit for assessment. In this module you are expected to complete three section assignments and a Final Module Assignment.

A special issue is presented in the Final Module Assignment. This issue relates to the use of water. You will have to research this issue. Then you must apply this research to make a decision about the issue. To do the necessary research, you will need access to a local library or the Internet.

The mark distribution is as follows:

Assignment Booklet 5A	
Section 1 Assignment	23 marks
Section 2 Assignment	40 marks
Assignment Booklet 5B	
Section 3 Assignment	29 marks
Final Module Assignment	53 marks
TOTAL	145 marks

Planning Ahead

Here is a list of materials and apparatus you will need to complete this module.

Section 1

- ❑ a 1-L container
- ❑ a measuring cup
- ❑ a 5-mL measuring spoon or a teaspoon
- ❑ a 15-mL measuring spoon or a tablespoon
- ❑ an eyedropper
- ❑ two small bowls
- ❑ blue food colouring (optional)
- ❑ a stream table (or a large baking tray)
- ❑ sand or soil
- ❑ an overhead lamp with a reflector
- ❑ a chunk of ice (5 cm to 8 cm across) with sand, gravel, and clay
- ❑ books or wooden blocks
- ❑ a metric ruler

Section 2

- ❑ a graduated cylinder or a measuring cup
- ❑ paper towels
- ❑ a large baking tray
- ❑ wooden blocks or books
- ❑ a protractor (optional)
- ❑ a balloon
- ❑ a waterproof felt marker
- ❑ a lamp or a flashlight
- ❑ a tennis ball or another small, round object

Section 3

- ❑ No extra materials are needed for this section.

For Section 1: Lesson 2, you will need to prepare a chunk of dirty ice at least a day before you do "Inquiry Investigation 5C: Glacial Grooving."

If you have access to the Internet, you may want to check out some of the links for this module ahead of time. Go to the following site:

http://www.mcgrawhill.ca/school/booksites/sciencefocus+8/student+resources/toc/index.php

Section 1

Water on Earth

You have probably quenched your thirst with a glass of ice-cold water many times. One or two cubes of ice floating on the water seem to be just right.

Imagine the glass filled with ice and only a small amount of water. The ice will eventually melt, but you would not have much water available to drink right away. However, with the glass filled this way, the contents are closer to the actual ratio of frozen to fresh water in Earth's water supply. Consider, too, that 97% of Earth's water supply is salt water.

In this section you will find out more about Earth's water supply and how it is recycled. You will see the many ways in which you depend on this supply of water. You will investigate the role of frozen water in geological changes. And you will appreciate the importance of frozen water as a reservoir of fresh water.

Lesson 1: A World of Water

Remember the last time you went to a lake or a swimming pool. To stay afloat you likely had to keep moving your arms and legs. Your experience would be different in Little Manitou Lake, Saskatchewan.

salt water: *water, such as ocean water, that is high in salt content*

Little Manitou Lake has unique properties. You would quickly discover that you can float effortlessly—in fact, you can lie in its water and read a book without getting the pages wet!

fresh water: *water from sources such as lakes, rivers, and rain that is low in salt content*

The high buoyancy is related to the water's high salt content. Little Manitou Lake water is more than three times saltier than ocean water.

biosphere: *the zones of air, land, and water where life exists*

Salt water in lakes is an exception; most lakes have **fresh water**. Yet, most of the water in the **biosphere** is salt water.

Turn to page 364 of the textbook. Read "Topic 1: A World of Water" to learn more about water on Earth.

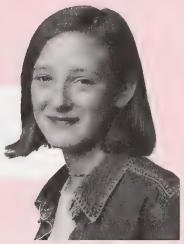
Water Uses

potable: *safe or suitable for drinking*

Have you ever gone for a long time without water? After a number of hours, your body's demand for water cannot be ignored. To go without **potable** water for a day is very taxing on your body. Water is very important to your life and lifestyle. Think about this as you read page 366 of the textbook. Pay special attention to "Pause and Reflect."

In this lesson, and in the rest of this course, you will be doing written work. You will sometimes be directed to an Assignment Booklet to do this written work. However, for the numbered questions in Student Module Booklets, you should answer the questions in a notebook set aside for Science 8.

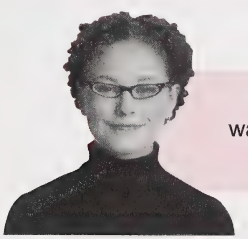
I write my answers in my notebook. There's lots of room there.



Also, use the notebook to record results while doing science investigations.

1. Compare the percentage of water in your body to the water in an apple and a watermelon.
2. On average, how much potable water does a person need to drink each day?
3. Estimate the amount of potable water (in litres) that you drink each day. Include juice, milk, soft drinks, and other beverages in your total. **Note:** A regular cup or glass is about 250 mL. Describe how your estimated amount compares to the average required amount.

Compare your responses with those in the Appendix on page 75.



Drinking water is not the only way you use water. See how you depend on water as you complete the following activity.

Find Out Activity How Do We Use Water?

Refer to the activity on page 367 of the textbook.

4. Follow the steps of "Procedure." Record your responses in your notebook.

Check your answers with your teacher or home instructor.

Going Further

Are you a water waster or a water-wise consumer?

Turn to page 365 in the textbook. Analyze the water use in your own home by doing "Inquiry Investigation 5A: Water at Home." You will gain a rough estimate of your family's average daily water consumption. Share your results with your family, and discuss ways you could conserve water.

These "Going Further" sections are for those of you who want to do extra in-depth work. There are lots of interesting topics to work on.

The Water Cycle

You may have enjoyed—or dreaded—a ride on a Ferris wheel. A Ferris wheel moves you in a cycle—a path that takes you high up and back down again over and over. Earth's water also moves in a continuous cycle. Driven by the Sun's energy, it circulates among the oceans and other bodies of water, the atmosphere, and the land in what is called the **water cycle**.

water cycle: the circulation of water—powered by the Sun—among the oceans and other bodies of water, the atmosphere, and land

Read "The Water Cycle" on pages 368 and 369 of the textbook to find out how water moves from one place to another—and back again.

5. Draw and label a sketch of the water cycle. Add and label an arrow from the vegetation into the atmosphere to represent transpiration, which is another important component in the water cycle. **Note:** Turn to pages 134 to 136 of the textbook to review the role of plants in the water cycle.

6. How long would it take for Earth's surface to become completely dry if there were no water cycle?

7. Is it possible that you could be drinking water that sea creatures swam in millions of years ago? Explain.

Compare your responses with those in the Appendix on page 75.

Going Further

Have fun with water and the water cycle! Do the "Problem-Solving Investigation 5B: A Water Cycle Model" on pages 370 and 371 of the textbook.

Do the following activity to help you visualize how Earth's water is distributed.

Find Out Activity: Water's Everywhere?

Materials

- water
- a large container (over 1 L in volume)
- a 1-mL and a 5-mL measuring spoon or a teaspoon
- a 15-mL measuring spoon or a tablespoon
- two small bowls
- an eyedropper
- blue food colouring (optional)

Procedure

Follow the given steps. For greater visual impact, you may choose to colour the salt water **or** the fresh water.

Step 1: Pour 1 L of water into your large container. You may add some blue food colouring to make the water more visible. Think of this as representing all the water (fresh water and salt water) on Earth.

Step 2: Remove 30 mL of water from the large container. Pour this water into a small bowl. This represents all the fresh water in the world.

Step 3: Remove approximately 6 mL of water from the small bowl. Put this into a second small bowl. This volume represents all the liquid fresh water in the world. The water remaining in the first bowl (24 mL) represents all the frozen fresh water.

Step 4: Use the eyedropper to remove some water from the second bowl. Release a single drop onto the table or counter top—return the remaining water to the bowl. The drop of water represents all the fresh water that is above the ground in lakes, rivers, and other bodies of water.

Throughout this activity, a tiny quantity—a trace—of water evaporated from your samples into the air. Approximately 0.0009% of Earth's water exists as a gas in the atmosphere.

8. What conclusion can you make about the distribution of salt water and fresh water on Earth?

Compare your response with the one in the Appendix on page 75.

Water for All?

Imagine going on a holiday trip and it's raining all the time! Rain may not be very welcome if you want to spend time outside. However, rain—and snow—are important sources of fresh water that feed rivers and lakes and soak into the ground.

Average annual precipitation varies a lot. For example, Port Alberni in British Columbia gets an average of 1910 mm of precipitation each year. Lacombe, Alberta, averages only 466 mm annually. Compare these amounts to the following:

- Iquitos, Peru: 2879 mm
- Mangalore, India: 3409 mm
- Tindouf, Algeria: 44 mm
- McMurdo, Antarctica: 8 mm

Precipitation can also be irregular. Most years in Mangalore, for example, there is virtually no precipitation for over two months, and more than two-thirds of the rainfall occurs over three months.

Read about the global distribution of fresh water on pages 372 to 374 of the textbook.

9. Define *surface water* and *groundwater*.

10. About what percentage of Earth's land areas is currently covered by ice? Have been covered by ice?

11. What four countries have nearly 50% of the world's renewable supply of fresh water?

12. **a.** What does water management involve?
b. What do humans need to know to manage water properly?

13. Answer questions 1 and 3 of "Topic 1 Review" on page 374 of the textbook.

Compare your responses with those in the Appendix on page 76.

Going Further

Express your artistic or poetic thoughts by trying the "Word Connect" on page 364 of the textbook or the "Pause and Reflect" on page 374.

Share your work with your teacher or home instructor.

Looking Back

You have seen in this lesson that Earth's biosphere contains a great deal of water. You and other organisms use water in many ways. The supply of water is continually reused in the water cycle. You have seen, too, that although the water supply is great, the amount of fresh water is very small and it has to be managed carefully.

Turn to Assignment Booklet 5A. Complete questions 1 to 5 from Section 1.

Lesson 2: Earth's Frozen Water

Penguins are part of the sensitive environment of Antarctica, which is Earth's coldest continent. Although it's technically mostly a desert—the average annual precipitation is under 8 mm—the ice cap contains almost 70% of the world's fresh water and 90% of the world's ice (frozen water). At its thickest, the ice sheet is almost 5 km deep. Huge icebergs break off the floating ice shelves to create an ever-changing coastline, habitat, and climate.

As you will find out in this lesson, massive ice sheets have also helped to shape Canada's landscape and environment. You will study the way the ice sheets move and the features they leave behind. You will also consider their relationship to the world's climate.

Icy Reservoirs (Glaciers)

Have you ever visited the Columbia Icefield? If so, you'll see a massive river of ice slowly flowing downward under the force of gravity.

To find out more about glaciers and how they move, read pages 375 to 377 and page 379 of the textbook. Carefully examine all the photos and illustrations.

The CN Tower in Toronto is not only 553 m tall, but it's the world's tallest freestanding structure. Covered by the Columbia Icefield, the tower's tip would barely come through the snow.

1. Explain the difference between the following.

   a. an advancing glacier and a retreating glacier
   b. *pack ice* and an *iceberg*
   c. a *valley glacier* and a *continental glacier*
   d. an *icefall* and a waterfall
   e. an *icefield* and a *glacier*

2. Create a flowchart that shows in detail how a glacier forms. Use all of the information about glacial ice formation at the top of page 376.

3. Could the continental glacier in Antarctica be called an ice cap? Explain.

4. In what two ways is a glacier like a river?

5. Glacial ice is a solid that flows under high pressure. Name two unique features that develop in the flowing glacier.

Compare your responses with those in the Appendix on page 76.

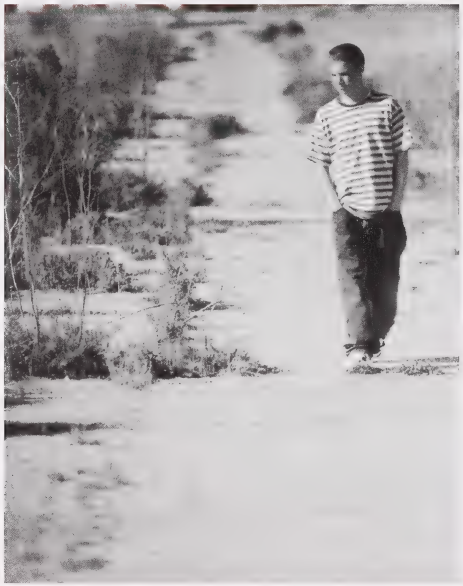
Going Further

You may enjoy investigating glaciers further by doing one or both of the following:

- There are ten major types of glaciers in the world—five of these are found in Alberta's Columbia Icefield. Use the "Internet Connect" on page 376 of the textbook to investigate further.

- Follow the directions in the "Find Out Activity: How Does a Glacier Move?" on page 378 of the textbook. You will make "slime" that can represent a glacier's movement.

Signs Left Behind by Glaciers



You walk along an abandoned country road. Weeds are growing in the cracks of the old pavement. Here and there you spot discarded fast-food containers. "I was here" is spelled out with twigs in another area. You are seeing evidence of the passing of time and also the signs of someone having been here before you.

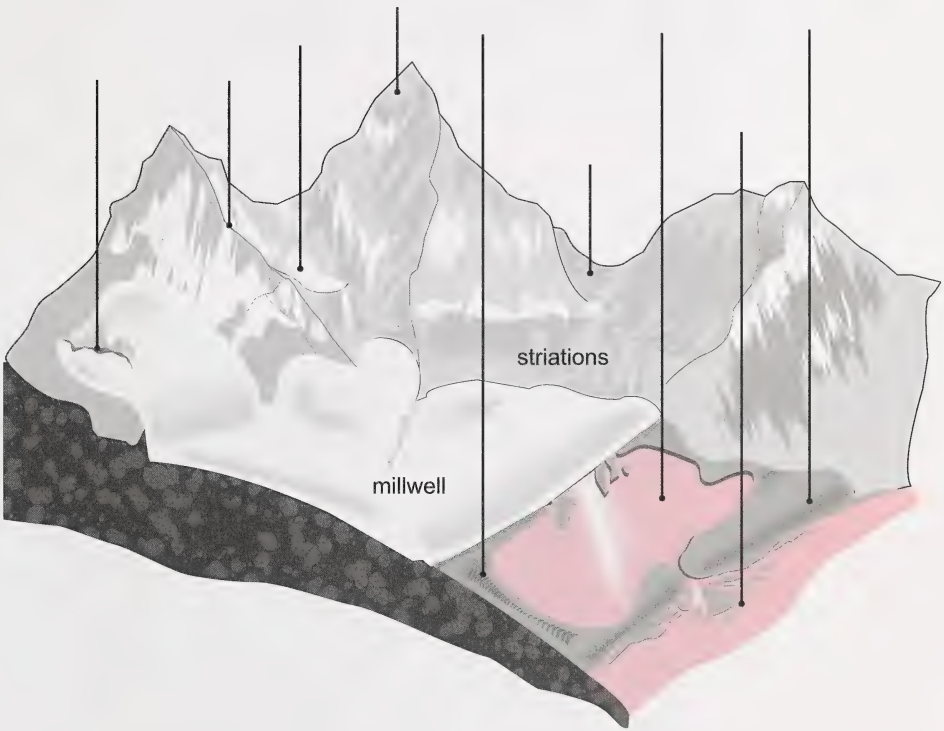
Glaciers also leave evidence of their movements and presence.

Find out about these signs as you read pages 380 to 382 and page 384 of the textbook. Look closely at the illustrations.

6. Use the diagram to complete the question. On the diagram, label these glacial features:

- cirque
- U-shaped valley
- esker
- arête
- crevasse
- meltwater
- horn
- moraine
- outwash

Glacial Features



7. What is an *erratic*?

Compare your responses with those in the Appendix on page 78.

Do Ahead

Prepare a chunk of dirty ice for the next investigation by freezing a mixture of water and debris—sand, gravel, or clay. The chunk of dirty ice should be about the size of your fist.

In the next investigation you will gain a better understanding of how the meltwater of a glacier can affect the landscape.

Investigation 5C Glacial Grooving

Refer to the "Inquiry Investigation" on page 383 of the textbook.

Do the steps of "Procedure." Record your observations in your notebook.

You may use either a large baking tray or a pan filled with sand or soil as a stream table. If possible, perform this investigation outside. Protect any work surface that could be damaged by water or soil.

8. Complete questions 1 and 3 from "Conclude and Apply" and "Analyze."

Compare your responses with those in the Appendix on page 78.

Ice Ages and Climate

Imagine living at a time when snow wouldn't melt—it would just keep piling up and the weather would remain cold year-round. If you lived in Alberta twenty thousand years ago, you would be living at a time like this—an **ice age.** Snow and ice up to 1.5 km thick covered most of Alberta.

ice age: any one of the several periods when glaciers covered much of Earth

Earth has had several ice ages, and there are many theories about what could have caused them. Read pages 385 to 387 in the textbook to learn more.

9. Why does increased snow and ice coverage cause a decrease in global temperatures?

10. a. Fill in the blanks. Your answers may require more than one word.

Climate-change hypotheses include the following:

- reduction of _____ from the Sun
- large volumes of _____ ash blocking the Sun's energy
- mountain-building processes causing an increase in reflective _____
- changes in ocean currents due to _____ movement
- changes in the _____ of Earth's axis or its _____ around the Sun

b. Scientists are currently gathering evidence to support or disprove these hypotheses. What observation made in 1991 supports the "volcano hypothesis"?

11. How does global warming differ from the greenhouse effect?

Compare your responses with those in the Appendix on page 78.

Going Further

Research ways that people can help reduce the amount of carbon dioxide released into the air. Try to find at least three global actions that nations have begun to try and decrease the level of greenhouse gases in the atmosphere. Refer to "Find Out Activity: How Can Global Warming Be Slowed?" on page 387 of the textbook. You may do this activity alone or include your family, friends, teacher, and/or home instructor.

12. Turn to page 388 of the textbook and answer questions 3, 5, and 7 of "Topic 2 Review."

Check your answers with your teacher or home instructor.

Looking Back

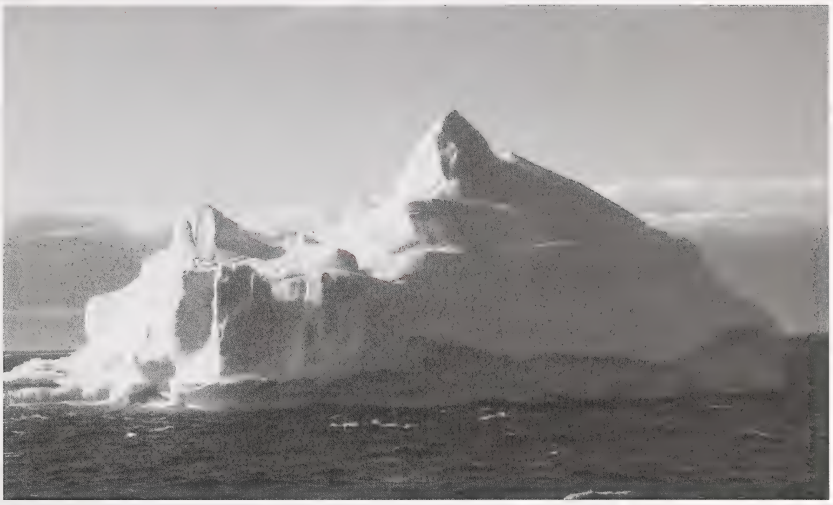
In this lesson you focused on Earth's frozen water. You found that glaciers have shaped Earth's surface as they move. Glaciers grow and shrink when Earth's climate changes.

Section Review

Water on Earth is essential to all living things. To review what you have studied in this section, turn to page 389 of the textbook and answer questions 1, 2, 3, and 5 of "Wrap-up: Topics 1 and 2." **Note:** You do not have to copy the statements in question 1. The data for question 5 is below question 6.b.

Compare your responses with those in the Appendix on page 79.

Conclusion



In this section you studied Earth's water supply and you examined how water is recycled. You became aware of the many ways you depend on this supply of water. You now know why this supply must be treated with care. You investigated the way frozen water shaped the land and how it is important as a storehouse of fresh water.

As you quench your thirst with a glass of water, you can appreciate why it is important to have a good supply of potable water. You realize that while there seems to be enough fresh water, you must manage this resource to make every drop count.

Turn to Assignment Booklet 5A. Complete questions 6 to 10 from Section 1.

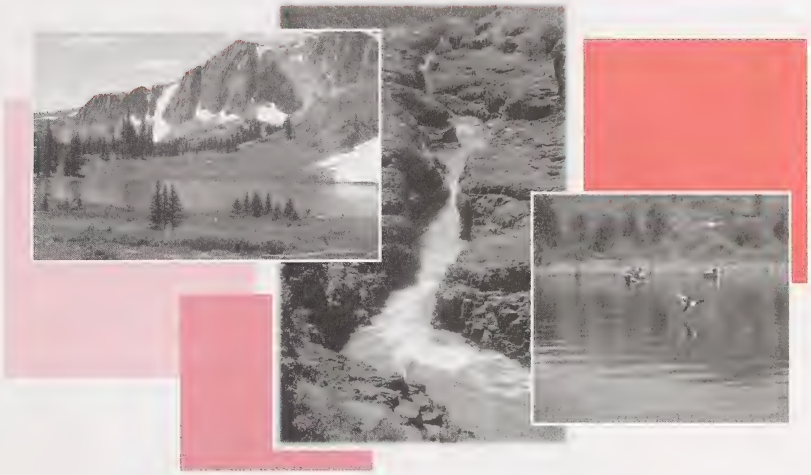
Section 2

Water Systems

The Government of Alberta legislature building sits on the north bank of the North Saskatchewan River. The North Saskatchewan River flows eastward from its source in the Rocky Mountains. It joins the South Saskatchewan River east of Prince Albert, Saskatchewan, and becomes the Saskatchewan River. It then drains into Hudson Bay through the Nelson River system in Manitoba. As it moves, it shapes the landscape. It is a water source for agriculture, industry, and human use along its way—irrigation, electrical power generation, the disposal of waste water, recreation (boating and fishing), livestock use, and drinking water. It is part of the global water cycle.

In this section you will follow a water journey—from fresh water to salt water. All of Earth's surface water and ground water is connected. Any local, natural, or human impact on a water system could have far-reaching consequences. You will look at how water affects the land and how the effects are monitored and controlled. You will also consider problems associated with too little or too much water and study how these problems can be decreased. You will also discover the important role that oceans play in global heat transfer and world climates.

Lesson 1: Freshwater Systems



You can enjoy the scenery of a freshwater lake or a waterfall. You appreciate being able to have safe water to drink and to use in and around your home. Thinking about the ways you and your family use water will remind you of the importance of fresh water.

However, fresh water makes up only about three percent of Earth's water—most of this water is in the form of ice. What's left is liquid **surface water** and **ground water**. With such a small fraction of Earth's water available for you and others to use, it's important to look after this kind of water.

surface water: water that is found above the ground, for example, in ponds, rivers, and oceans

ground water: water that has seeped down under Earth's surface to fill pores and cavities in soil and rock

Where Is Fresh Water Found?

The most visible forms of fresh water are lakes, ponds, and wetlands (still bodies of surface water) and streams, waterfalls, and rivers (moving surface water). However, the majority of all fresh, liquid water exists as ground water that fills the pores and cavities in soil or rock.

Read pages 390 and 391 of the textbook to understand the difference between these freshwater supplies.

1. Why are wetlands important?

2. You have studied the important role that transpiration from plants plays in returning ground water to the atmosphere. What barrier prevents ground water from soaking deep into the ground beyond the reach of plants?

Compare your responses with those in the Appendix on page 80.

Going Further

It's time to combine science with literature. Get creative with "Word Connect" on page 390 of the textbook.

Has "Off the Wall" on page 390 made you curious? Find out why the water of some lakes is salty. Examples include Lake Wakaw, Saskatchewan, and Great Salt Lake in Utah.

Freshwater Links: The Watershed Concept

A raindrop landing on a roof like the one in the photo can end up going down in any one of four directions—to the left, the right, the front, or the back of the house. Each of the roof surfaces is like a **watershed**.

watershed: the entire area drained by a stream and its tributaries

Imagine a worker accidentally spilling roofing tar near the top of the roof. The spill will not stay in one spot; instead, the tar will contaminate more of the "watershed" as it flows down. That makes it harder to clean up the mess.

Using the roof as a model helps you to understand how water follows real watersheds along the slope of the terrain. Look at the maps on pages 392 and 393 of the textbook.

Water in Western Canada could go north to the Arctic Ocean, east to Hudson Bay, south to the Gulf of Mexico, or west to the Pacific Ocean. Think of the Rocky Mountains as the peak of the roof in the watershed model. You can see how a chemical spill in one area could contaminate all the water downstream in the watershed—just like the spill on the roof, the chemical spill flows downhill with the water.

headwaters: the source or upstream areas of a watershed

Looking after a watershed is important—not only because contaminants flow and spread downhill. Measuring the amount of water in the **headwaters** of a watershed can help determine the availability of water to consumers farther down the watershed. Monitoring the sediment load and flow rate can help to identify erosion problems in the watershed.

Read pages 392 to 394 in the textbook to understand more about watersheds.

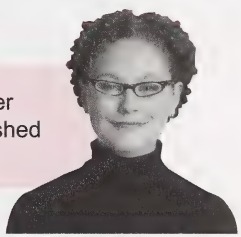
3. Define *run-off*.

4. **a.** What watershed covers most of northern Alberta?
b. What watershed covers most of southern Alberta?

5. Name three factors that influence the outflow of a watershed.

Compare your responses with those in the Appendix on page 80.

In the next activity you will discover some characteristics of the watershed where you live.



Find Out Activity Where's Your Watershed?

Refer to the activity on page 393 of the textbook.

Locate a map of your local area. You may use the local library or the Internet.

For maps, you can go to the site **http://atlas.gc.ca** from the Government of Canada. This site has helpful maps showing place names, rivers, and drainage basins. There are two ways to get to such maps after you are on the site:

- Select "English." Move your pointer to "Environment." Then on the cascading menu, move your pointer to "Hydrology" and select "Drainage Basins."
- Select "English." Move your pointer to "Freshwater." On the cascading menu, move your pointer to "Distribution of Freshwater" and select "Drainage Patterns."

For Alberta, additional maps can be found on the site **http://www.gov.ab.ca**. Use the search tool with the expression *water basins*.

6. Complete steps 1 and 3 of "Procedure" from page 393 of the textbook.

7. Complete questions 1 and 3 of "What Did You Find Out?"

Check your answers with your teacher or home instructor.

Run-off and Erosion

erosion: the carrying away of weathered rock or soil materials by water, wind, or ice

sediment load: rock material carried in water over a certain time

deposition: the laying down of eroded materials—sediment

What happens when you knock over a glass and spill a drink while sitting at a table with other people? If the table surface is hard and smooth, somebody will have to get up really fast to avoid getting hit by the run-off. If there is a tablecloth, the spill will not flow as fast. Some of the liquid will soak into the pores of the cloth.

You can think of rain as a spilled drink and the table surface—with or without the tablecloth—as the ground surface. Rain can flow over the surface of the ground, soak into the ground, or evaporate. However, when water flows over the ground, it can have additional effects on the ground, which you would not see on the table. For example, a river can carve out a deep valley. The formation of the valley is due to **erosion**.

When moving water causes erosion and then slows down or stops moving, it drops its **sediment load**. The result is **deposition**.

Turn to pages 396 and 397 of the textbook and read "Run-off and Erosion."

8. Which stores more water—urban or rural areas? Explain.

9. Give three factors that determine how a river shapes the landscape.

Compare your responses with those in the Appendix on page 81.

You have seen that run-off is the water that flows across Earth's surface. As water moves, it affects the land around it. The land also affects the flow of the water.

In the next investigation you will use a model to explore how land affects run-off. You will have to do some thinking about what procedure to use. Try to get a friend or a family member to help you plan and carry out the investigation.

Investigation 5D What Happens to Run-off?

Refer to the "Inquiry Investigation" on page 395 of the textbook.

The scientific question you are to investigate is this:

How will run-off be affected by changes in land slope and land surface?

You need to have a clear idea of what effect you want to focus on. Some effects of run-off include the following:

- how long it takes for water to flow
- how much water is absorbed

Do step 1 of "Procedure."

Tip: The bottom of a cake pan can be used as a type of surface. The textbook investigation mentions a plastic surface. The bottom of the cake pan would be impermeable like a plastic surface.

You may build a different surface by placing paper towels on the bottom of the cake pan. For another type of surface, you may place sponges on the bottom of the cake pan.

10. You will design an investigation to study how the type of surface or the slope of the surface will affect run-off. You may study both factors.

a. Name the manipulated variable and the responding variable.

b. Name a controlled variable.

c. Write down the specific question you are investigating. It should be in this form: How does the MV affect the RV?

d. Give a brief description of your procedure.

e. Make a data table for recording your observations.

Check your answers with your teacher or home instructor.

Make sure your teacher or home instructor approves of your procedure. This approval is to make sure your investigation is safe. You may also get some pointers on how to make the investigation better.

Do the steps of your procedure once you have the go ahead from your teacher or home instructor.

11. Analyze your data. Make a conclusion from your investigation. The conclusion should answer the specific question you are investigating.

12. This investigation is a model of rainwater falling on different surfaces. You can apply your conclusion to real raindrops after they land. Complete the following sentence in a way that applies your conclusion to the real world.

Raindrops falling on _____ travel more quickly than raindrops falling on _____. This is because _____.

Check your answers with your teacher or home instructor.

River Monitoring

Watching and keeping track of a river and its water—both directly and with scientific instruments—is a special kind of monitoring. Monitoring river flow is a way of keeping in touch with the health of a river.

Have you looked at a river flowing in the spring? If so, you may have done some monitoring. You would soon discover interesting river characteristics. The river may have flowed wildly and almost overflowed its banks. Aside from the high **streamflow**, you may have noticed the water looking muddy. Later in the summer, when the streamflow was low, the river water was clearer.

streamflow: the measure of speed and volume of water moving in a stream

Why do water characteristics change when the strength of the river decreases?

When water flows lazily in a river, there isn't enough energy to keep particles suspended. So the water looks cleaner.

Read pages 400 to 402 in the textbook to find out how scientists monitor a river. You will also discover how rivers can be restored and maintained in their natural condition.

Going Further

You learned from the reading that vegetation along riverbanks is important. For more information about the importance of this green zone, go to **http://www.cowsandfish.org/greenzone.html**. A riparian area is the land along a river or the land sloping down to a river.

13. List five types of information that streamflow monitoring can provide.

14. What is the relationship between a river's flow rate and its ability to transport sediments?

15. What can scientists and engineers determine by studying the quantity, quality, and characteristics of sediments in a river or stream?

Compare your responses with those in the Appendix on page 81.

Going Further

Find out how fast a local river flows. How long would it take this river to fill an Olympic-sized swimming pool? Try "Internet Connect" on page 401 of the textbook.

Ground Water

In 2000, seven people died and hundreds of others became very ill after drinking tap water in Walkerton, Ontario. The town's ground water well became contaminated by E. coli bacteria from nearby feedlots.

With many farms, acreages, communities, and most campsites relying on ground water as their main source of fresh drinking water, protecting this valuable resource is very important. The constant monitoring of a water supply helps protect consumers—for both the quality and the quantity of water.

Read pages 403 to 406 in the textbook to learn more about ground water.

16. Sketch a labelled diagram to illustrate these terms:

- permeable material
- impermeable material
- aquifer
- water table

17. Write definitions for the following terms: *river*, *contamination*, *point source*, and *non-point source*.

18. **a.** What will happen to the water table if too many people draw water from an aquifer?
    b. Predict the effect of several years of below-average precipitation on the water table.

Check your answers with your teacher or home instructor.

Going Further

You may try one or both of the following:

- Investigate the ability of different materials to hold water. Follow "Procedure" for "Find Out Activity: How Much Pore Space?" on page 404 of the textbook.

- To create a fun and interesting scientific model, try "Find Out Activity: Make a Model Aquifer" on page 405 of the textbook.

Too Little or Too Much?

Imagine not watering your garden during a hot, dry spell. Having too little water can cause plants to die and the soil surface to crack. On the other hand, too much water can lead to floods.

To control water in certain regions, rivers are diverted—the river water is made to flow along a path that is different from its natural riverbed. Dams divert rivers. Many urban communities use diverted water. Dry-area farmers also use diverted water. They use this water to irrigate crops.

Unfortunately, irrigation causes its own problems. You may have noticed a whitish deposit on soil in potted plants growing at your home. That is due to salts and other minerals—originally dissolved in the water used to water the plants—left on the soil after water evaporates. In a similar way, salts, other minerals, and sometimes poisons are left on farm soils as irrigation water evaporates. Over many years, these deposits can be harmful to crops.

flood plain: a flat area bordering a river that is naturally subject to flooding

Such a plain is often created by soil deposited during floods.

In 1994, Alberta experienced a short period of having too much water. Rivers in southern Alberta flooded to a peak of 20 m above the usual water level. Many animals drowned, and a lot of property was destroyed. It's important to prevent this type of flooding.

But at the same time, **flood plains** need to be flooded occasionally so certain plants can grow—such as the cottonwood trees of southern Alberta. These trees need river flooding to make their seeds germinate.

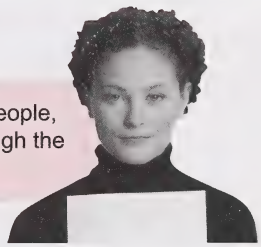
To find out more about managing water with dams, read page 408 in the textbook.

19. There are pros and cons to building dams.

a. List two positive consequences of building dams.
b. List two negative consequences of building dams.

Compare your responses with those in the Appendix on page 81.

Predicting floods can help save people, animals, and property. Work through the next activity.



Find Out Activity Predicting Floods

Refer to the activity on page 409 of the textbook.

20. Read the three paragraphs of the introduction. Complete questions 1 and 2 of "What Did You Find Out?"

Check your answers with your teacher or home instructor.

21. Answer questions 4 and 5 of "Topic 3 Review" on page 409 in the textbook.

Check your answers with your teacher or home instructor.

Looking Back

The effective management of freshwater resources helps to maintain a dependable supply of water that is so important to humans and other living things. Such management can also prevent the contamination of freshwater resources.

Turn to Assignment Booklet 5A. Complete questions 1 to 9 from Section 2.

Lesson 2: The Oceans

Have you noticed that waves crashing onto a beach have a beautiful, repetitive motion? Waves are only a very small, surface movement of a water body. The global ocean—all Earth's oceans are connected—is a great body of salt water that is continuously in motion. Waves, tides, and ocean currents move water and carry material around the globe and affect coastlines, ecosystems, and climates.

Ocean Water

Hiking, playing floor hockey, or running to catch a bus . . . everybody has broken out in a sweat at one time or another. You lick your lips and realize that sweat is pretty salty! Well, ocean water is even saltier. It's fine to swim in but not something you want to drink.

The water in the ocean is classified as salt water. What does this really mean in terms of solute concentration? Where did the salts and other dissolved minerals come from? Find out as you read pages 410 to 412 in the textbook.

There are many interesting facts about salt water.

1. a. What fraction of Earth's surface is covered by oceans?

b. How deep would the salt be if all the salt in the oceans were dried and spread over the whole Earth?

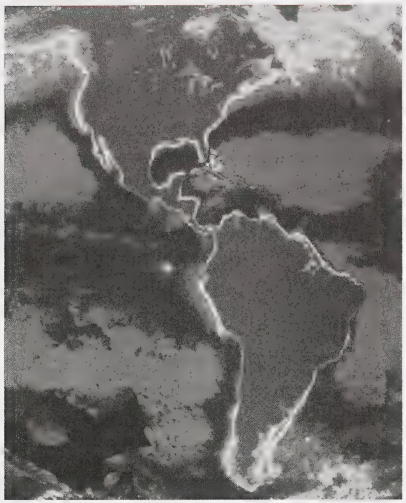
Compare your responses with those in the Appendix on page 82.

Going Further

Are you still curious about the salts in the ocean? Try one or both of the following:

- Have your ocean-related questions answered by a marine scientist. Follow the "Internet Connect" on page 410 of the textbook.
- You have read that the oceans get their salts from the land. How do the salts leave the land and get into the ocean? You will answer this question in "Find Out Activity: How the Ocean Gets Its Salt" on page 412 of the textbook.

The Ocean Floor



Imagine trying to explore the ocean floor. You could walk a little ways into the ocean. You could scuba-dive a little beyond that. However, parts of the ocean floor are thousands of metres below the water surface and only recently became accessible to humans.

In the 1920s, scientists began to map the ocean floor with sonar radar—a technology that reveals bottom features using reflected soundwaves—somewhat like the detection system used by bats.

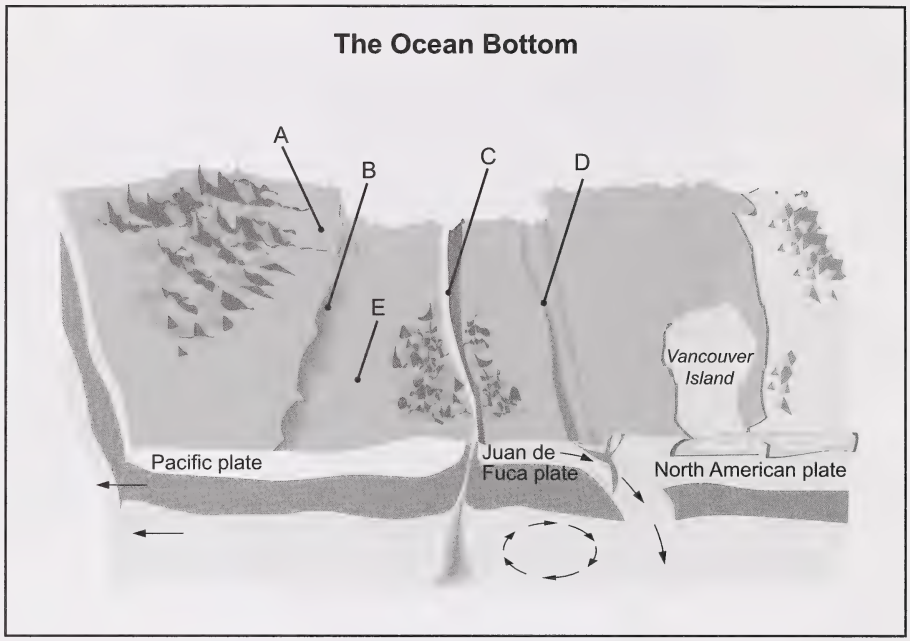
Using new technologies, marine scientists have studied

- where things live along the ocean-floor
- water and material movements in ocean currents
- global weather patterns above ocean water

They have even discovered that the ocean floor moves—but at a snail's pace.

If you were to pilot a deep-sea submarine to the bottom of the ocean, what would you see? To find out, read pages 413 to 415 of the textbook. Look carefully at the illustrations of the ocean floor.

Use the following diagram to answer question 2.



2. On the diagram, capital letters designate features of the ocean bottom. Identify these features by placing the appropriate capital letter in each answer blank.

_____ **a.** trench

_____ **b.** ocean ridge

_____ **c.** continental slope

_____ **d.** continental shelf

_____ **e.** abyssal plain

Check your answers with your teacher or home instructor.

Going Further

Try the "Internet Connect" on page 413 of the textbook to learn more about the ocean floor and satellite imagery.

Refer to the "Think and Link Investigation" on page 416 of the textbook. Read "Think About It."

3. **a.** Create a graph by following the steps of "What to Do."
   b. Do questions 1 to 3 of "Analyze."

Check your answers with your teacher or home instructor.

How Waves Change Shorelines

Picture yourself sitting on a surfboard out in the ocean—you're trying to catch the perfect wave. As the wave approaches you paddle forward to match its speed. Before you know it, you've caught the wave. You stand up and ride the wave until it breaks on the shore. What created your breaking wave? Where do waves come from? How do they interact with the land?

Wave action is similar to that of a river—it causes erosion in some areas and deposition in others. This, in turn, creates shorelines ranging from long, sandy beaches to imposing cliff formations.

Read pages 417 to 419 of the textbook to explore ocean waves.

4. Define *wave*, *swell*, *breaker*, and *longshore current*.

5. The distance from crest to crest is a _____. Between the crests there is a _____.

Scientists make models of ocean waves splashing on a beach to find out the effects of real ocean waves. Look at "Inquiry Investigation 5G: Waves and Beaches." It's on pages 420 and 421 of the textbook. It uses small models that are made with water, a pan, and sand or gravel.

From "Hypothesis" of this investigation, you may be able to identify possible manipulated variables and responding variables.

Possible manipulated variables (MVs) for the investigation are

- slope
- type of materials

Responding variables (RVs) could be the following:

- size of the beach
- shape of the beach

6. Suppose you did "Inquiry Investigation 5G." What testable question could you make to start the investigation?

Reminder: A testable question is like the following:

With a change in the MV, how does the RV change?

Check your answers with your teacher or home instructor.

Developing testable questions is an important skill for anyone doing any kind of science investigation.

Going Further

Maybe you would like to investigate the effects of waves on beaches. You already have a testable question to get you started.

Complete the steps of "Inquiry Investigation 5G: Waves and Beaches" on pages 420 and 421 of the textbook.

How Beaches Are Formed

Have you and your family visited a coastal beach? Perhaps you even live on a coast. Was the sand very fine or quite grainy and gritty? Were you able to find seashells and other signs of sea life? How are beaches formed? What effects do waves have on beaches?

Read page 422 of the textbook to see if your ideas are correct.

7. At what time of the year are beaches usually formed? Why?

8. What can be done to prevent the loss of sand at beaches due to wave action?

Compare your responses with those in the Appendix on page 82.

Going Further

Is the ocean awe-inspiring to you? Refer to "Word Connect" on page 422 of the textbook. Think about the poem and share your thoughts with someone else. Try writing a poem of your own to share with others.

Tides

The caption of the photo to the left could be "Waiting for High Tide." Will the water truly rise above the boat launch? In some places in the world, ocean tides are hardly noticeable. In other places the tides can rise 20 metres. Piers have to be raised well above low-tide levels. What causes tides to move water around on Earth's surface?

Read pages 423 to 425 of the textbook to understand how tides are created. Carefully study each diagram.

spring tide: *the tide with the highest tidal range*

Spring tides occur when the Moon, Earth, and Sun are aligned.

neap tide: *the tide with the lowest tidal range*

Neap tides occur when the Moon and Sun are at right angles to each other in relation to Earth.

tidal range: *the difference in height between high and low tides*

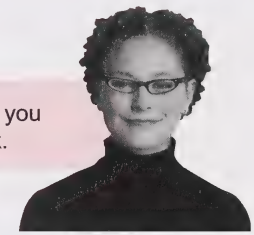
9. Why are **spring tides** higher than **neap tides**?

10. What shape of shoreline can cause the **tidal range** to increase?

11. Do the "Stretch Your Mind" activity on page 424 of the textbook. Predict the low-tide time for July 2.

Compare your responses with those in the Appendix on page 82.

Do the next activity to help you understand how tides work.



Find Out Activity Tidal Tales

Refer to the activity on page 425 of the textbook. Find a partner to help you. Follow the steps of "Procedure."

12. Complete questions 1 and 2 of "What Did You Find Out?"

Check your answers with your teacher or home instructor.

Going Further

Try "Find Out Activity: Winds and Currents" on page 426 of the textbook as a simple introduction to currents, which are another effect of wind on water.

Ocean Currents and Climate

You have probably observed that wind creates waves on the surface of puddles and ponds. The stronger the wind, the larger and more powerful the waves.

Winds that push surface water into waves also drive large "rivers" of water—**currents**—around the oceans. These circular currents significantly affect the world's climates and are responsible for carrying many materials—from debris to plants and animals—from one part of the world to another. Many organisms rely on these currents for survival. An oilspill or other disaster occurring in a current results in even greater damage. Why?

current: the continuous movement of water in another, larger body of water

Read about currents of air and water on pages 426 and 427 of the textbook. You will discover three factors that affect these currents.

13. How do currents differ from waves?

14. Define *trade winds* and *westerly winds*.

Compare your responses with those in the Appendix on page 82.

Even if you live on the Canadian prairies, you have likely heard of "El Niño." El Niño is a warm ocean current. It's thought to be responsible for a variety of negative, global environmental effects.

In some years, a weakening of the trade winds allows this warm, nutrient-poor current to flow farther south than normal along the Peruvian coastline. Higher water temperatures kill the plankton, forcing larger organisms to starve or leave the area. Around the world, severe droughts or floods result from changes in evaporation rates and air-current patterns due to El Niño.

On pages 428 and 429 of the textbook, read about the influences of major currents in the Atlantic Ocean.

15. Define *climate*, *weather*, and *heat capacity*.

16. **a.** Which warm-water current keeps Britain's climate mild during winter?
b. Where does this ocean current come from?

17. Answer questions 2, 3, and 6 of "Topic 4 Review" on page 430 of the textbook.

Check your answers with your teacher or home instructor.

Going Further

Try one or more of the following activities:

- Follow the instructions in "Pause and Reflect" on page 427 of the textbook to observe how Earth's rotation affects the wind direction.
- For fun with mud and water, try question 9 of "Topic 4 Review" on page 430 of the textbook.
- Visit the NASA Internet site at **http://www.nasa.gov** to learn more about El Niño. You can also view related images and animations. Click on "Enter NASA.gov" and then search "El Niño."

Looking Back

In this lesson you found out that the global ocean is always moving and affecting the things around it. Erosion and deposition are constantly changing coastlines. Ocean tides and currents affect climates and the distribution of living things. Ocean waters receive and transport dissolved chemicals and suspended materials across the globe.

Section Review

Complete questions 1 and 2 and 9 to 13 of "Wrap-up: Topics 3 and 4" on page 431 of the textbook. **Note:** You don't need to copy the statements in question 2. Add *tsunamis* to the list of key terms.

Check your answers with your teacher or home instructor.

Conclusion

All Earth's water systems—fresh and salt, surface and ground—are connected. In this section you looked at the flow of water on land and how this is monitored and controlled. You also studied the role of oceans in global effects.

Imagine yourself sitting in a canoe, floating along a river in Canada. Where would you go if you just let the canoe float along on its own? You could travel down the river system, eventually reaching the ocean. Once in the ocean you might travel around Earth on ocean currents driven by winds. You would have made an incredible journey possible due to the connectedness of Earth's water systems.

Turn to Assignment Booklet 5A. Complete questions 10 to 15 from Section 2.

Section 3

Aquatic Ecosystems and Water Quality

Have you ever imagined what it would be like to live underwater, just beneath the waves? You'd have no busy streets or noisy lawnmowers. Instead, you'd have quiet reef gardens displaying rainbows of colours illuminated under soft light. More than half of Earth's organisms live in, on, or around a water environment. Aquatic environments support a wide variety of complex and awe-inspiring ecosystems.

Did you know that aquatic environments are also essential for life on land? Many food products come from plants and animals that live in water. Seventy percent of the oxygen you breathe comes from plants and phytoplankton in the oceans. And drinking water, which is essential to all life, is stored in aquatic environments. Therefore, water quality and quantity should be of concern to you.

In this section you will investigate living things found in different bodies of water and see some of the ways they have adapted to their environments. You will review the food web, which shows how living things interconnect. People have large impacts—both good and bad—on aquatic environments. You will examine some of these effects and look at some techniques for monitoring water quality.

Lesson 1: Living in Water

Are you familiar with amphibians? These are animals that start life in water and undergo physical changes that enable them to survive on land. Some plants, too, are able to live in water and on land. Other animals and plants can be classified as terrestrial (land-living) or aquatic (water-living). Within these habitats, conditions may vary a great deal. The types of animals and plants that live in the different regions also vary.

The habitats of aquatic animals and plants are as diverse as the land you live on, from cold to very hot, sunlit to pitch-black, fresh water to salt water. What lives where, why, and how? In this lesson you will explore the habitats of some aquatic organisms and look at several adaptations that enable organisms to live in their specific niches.

Aquatic Habitats

There are many different aquatic habitats in the world. The three most common types are still fresh water (lakes and ponds), moving fresh water (rivers and streams), and salt water (oceans, seas, salt lakes, and estuaries). The organisms that live in and around these habitats show great **diversity**, due to the differing demands of their habitats and lifestyles.

diversity: variation; differences

Read more about life in these habitats on pages 432 and 433 of the textbook.

1. Compare the general characteristics of a lake and a pond. Use a data-table format.

2. In the aquatic habitat of the oceans, why are most marine organisms found in the top 180 m of water?

Compare your responses with those in the Appendix on page 83.

adaptation: a change in structure, form, or habit that increases an organism's chances of surviving and reproducing

Adaptations for Aquatic Life

Animals and plants that live in water are very different from those you would see on land. Some aquatic **adaptations**, such as gills or fins, are obvious. Others, like the swim bladders many fish use to change their buoyancy, are less obvious.

Read pages 434 to 436 of the textbook to see how some animals have adapted to aquatic life.

3. Name two ways that aquatic animals have adapted to avoid being swept away by moving water.

4. What special adaptation allows whales and dolphins to stay underwater for a great length of time?

5. List three adaptations that aquatic animals have developed to filter food out of the water.

Compare your responses with those in the Appendix on page 83.

Going Further

You may wish to do one or both of the following:

- What is life like in a pond or in the ocean? Follow the links in "Internet Connect" on page 435 of the textbook to find out.

- Are you creative, artistic, or just plain curious about aquatic adaptations? Then follow the directions in "Pause and Reflect" on page 436 of the textbook. Share your work with a friend, your family, your teacher, or your home instructor.

marine: having to do with salt water or the oceans

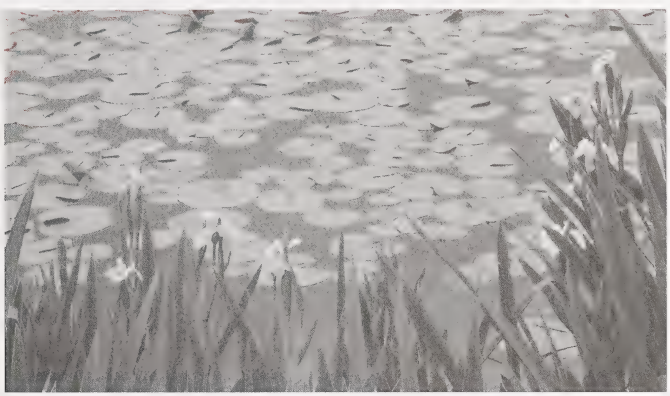
Could aquatic organisms easily switch water environments? For example, what would happen to a **marine** animal if it were placed in a freshwater environment.

Amazingly, some aquatic animals have adapted to live in both salt water and fresh water. Read "Did You Know?" on page 437 of the textbook to discover more.

6. What allows salmon to tolerate changes in salinity?

Compare your response with the one in the Appendix on page 83.

Aquatic Plants



Plants have also adapted to living in different aquatic environments. Some float on the water surface and others are rooted or attached to the bottom of the body of water. Some plants are submerged all the time, while some grow from the depths of the water to the surface.

Read pages 437 to 440 in the textbook to examine some aquatic plant adaptations.

7. What is the difference between the two main types of aquatic plants?

8. Give two reasons why some aquatic plants have leaves and flowers on the surface of the water.

9. Why doesn't seaweed require roots?

Compare your responses with those in the Appendix on page 83.

Going Further

Explore the world of aquatic plants. Try one or more of the following:

- Aquatic plants have many similarities to land plants. They also differ in many ways. Try the "Find Out Activity: Plant Adaptations" on page 437 of the textbook.
- To find out how temperature affects the amount of dissolved gases in water, do "Find Out Activity: Dissolved Gases," on page 439 of the textbook.
- Do any of the foods in your home contain seaweeds? Do "Pause and Reflect" on page 439 of the textbook to discover the answer. Carrageenan, algin, and agar are all substances taken from seaweeds.
- Plankton are drifters that are carried aimlessly around the oceans by currents. Follow the instructions for the "Find Out Activity: Design a Drifter" on page 440 of the textbook. You will design and build your own specially adapted drifter.

Nutrients for Aquatic Plants

All plants require nutrients to grow. Many aquatic plants absorb these nutrients directly from the water. Most nutrients are washed into water from the land. However, some come from detritus. There are many factors that affect the abundance or scarcity of nutrients in water.

Read page 441 and the top of page 444 in the textbook to find out about the availability of aquatic nutrients.

10. Define *detritus*, *algae*, and *decompose*.

11. Why does temperature mixing increase nutrient content near the surface?

12. An algal bloom is caused by an unnatural increase in nutrients in a body of water. Explain why the oxygen content of water goes down after an algal bloom.

Compare your responses with those in the Appendix on page 84.

Going Further

You wouldn't think that nutrients could be bad. Investigate a negative effect that humans can have on aquatic environments when they let nutrients go out of control.

Refer to "Inquiry Investigation 5H: Too Much of a Good Thing" on pages 442 and 443 of the textbook. Do all the "Procedure" steps except 10, which requires a special test kit. Discuss your analysis and conclusions with a friend, a teacher, or your home instructor.

Ask your teacher or home instructor for instructions about the fertilizer's disposal.

Food Chains and Food Webs

Animals must eat plants or other animals to survive, as they do not have the ability to make food like plants do. Food chains and food webs show which animals eat which plants or other animals. Human activity can affect food webs. Fisheries on Canada's East Coast were almost shut down due to a severe decrease in the number of cod. Was it their place in the food chain that cased their decrease in numbers? Was this decrease caused by overfishing, pollution, or just a natural event?

Look further into aquatic food chains and webs by reading "Aquatic Food Chains" and "Fishing" on pages 444 and 445 in the textbook.

13. What organisms form the base of many aquatic food chains?

14. A change in one part of a food web can affect other parts of the food web. Refer to the food web on page 444 of the textbook. Suppose the seal population is reduced. What effect will this have on the herring population?

Compare your responses with those in the Appendix on page 84.

Biomagnification of Toxins

toxin: a chemical that can cause harm to living things

biomagnification (bioaccumulation): an increase in the concentration of toxins as they move up the levels of a food chain

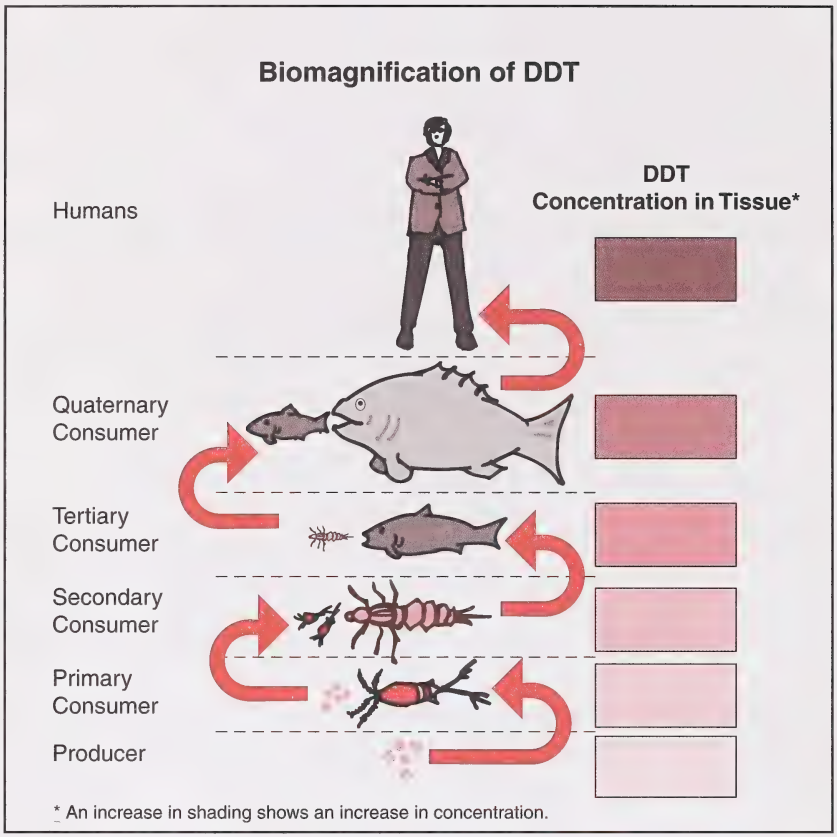
The concentration of harmful chemicals (**toxins**) in a food chain can increase to dangerous levels through the process of **biomagnification** (**bioaccumulation**).

Animals at higher levels in the food chain, especially those with a lot of fatty tissue, may be especially affected by poor health, reproduction problems, and even death.

Look at the following chart.

DDT: a colourless and odourless insecticide

DDT is harmful to humans and animals. DDT tends to build up to toxic levels because of biomagnification. Although DDT is insoluble in water, it is soluble in fat. DDT is banned in North America but is used in many other countries.



Read page 446 in the textbook to understand more about biomagnification.

15. In what part of an animal's body do most toxins accumulate?

16. Draw the biomagnification food chain described in the reading. **Note:** When you draw a food chain, you can use names rather than pictures.

Compare your responses with those in the Appendix on page 84.

Special Aquatic Habitats

Everything about Banff National Park seems to shout BIG! However, the Cave and Basin National Historic Site of Canada, located on the southwest edge of the Banff townsite, is home to a unique snail. This snail has adapted to the unique habitat formed by the very warm, sulphur-rich waters of the springs.

There are many other unique habitats. Read "Exploring Aquatic Habitats" on page 447 of the textbook to find out more information.

17. There are bacteria that live near vents (cracks) on the sea floor. What allows these bacteria to make their own food in the absence of sunlight?

18. Answer questions 3 and 5 of "Topic 5 Review" on page 447 of the textbook.

Check your answers with your teacher or home instructor.

Looking Back

The life of a dolphin, an otter, or a Canada goose seems so carefree and appealing.

This type of life may seem appealing but it is highly dependent on the quality of the water that sustains it. Aquatic animals are amazingly well-adapted to their habitat. But life for these creatures becomes uncertain when the quality of their environment declines—either naturally or through human actions.

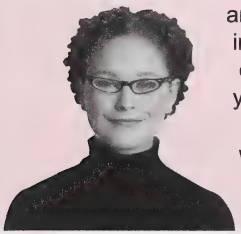
In the next lesson you will examine how experts test, monitor, and manage local and global water quality. You will also look again at processes of water purification.

Turn to Assignment Booklet 5B. Complete questions 1 to 8 from Section 3.

Lesson 2: Water Quality and Water Management

Can you tell water quality simply from looking?

Imagine a warm day. You've been hiking all day and would like to freshen up by taking a dip in a lake. Lake 1 has a marshy shoreline with plants, reeds, and algae growing around the edge. Organisms wriggle in the muddy bottom and murky water. Lake 2 has a clean, rocky shoreline. The water is crystal clear and you can see through the depths to its sandy bottom.



Which lake would you choose to take a dip in?

I think I'll go for Lake 2. Besides cooling off, I'd like to get clean.

Actually, one of the lakes is polluted. Knowing this, which would you choose?

According to what we've learned, it's very likely that Lake 2, being lifeless, is the polluted one. So I'd choose the muddy lake. It might feel more like a mud bath, but I'd like to avoid the pollution.

Given the added information, it now makes sense to change your mind. Wouldn't it be nice to be able to judge water quality reliably?

In this lesson you'll look at ways to determine water quality and you'll consider several ways that humans affect it. You'll also find out how you can take an active part in protecting water quality in your area.

Water Quality

What is water quality? It's a measure of how healthy the water is. In a natural environment, healthy water is not necessarily "pure" water. Healthy water can have many things dissolved or suspended in it. Crystal-clear water may be very unhealthy.

To understand how some particles in water are good and others are bad, read pages 448 to 450 in the textbook.

1. Define *dissolved solids*, *hard water*, and *soft water*.

2. List four ways that micro-organisms, chemicals, and sediments can get into a water system.

Compare your responses with those in the Appendix on page 85.

Find Out Activity Water Across the Nation

Refer to the activity on page 450 of the textbook.

You may wish to use the Atlas of Canada website as your atlas (**http://atlas.gc.ca**). Or you may want to use the following Natural Resources Canada website:

http://geonames.nrcan.gc.ca/search/search_e.php

You may use a spreadsheet program to draw your graph. **Note:** Delete "Coulais River" from the list. "Explois River" should read "Exploits River."

3. Do questions 1 and 2 of "Procedure."

Check your answers with your teacher or home instructor.

Water and People

People affect water quality. From earliest times, as populations increased and people concentrated into towns and cities, the negative impacts on local water quality increased.

With modern industrial, commercial, agricultural, and domestic activities releasing more toxic substances (toxins) into the water systems, the cause for concern grows ever larger.

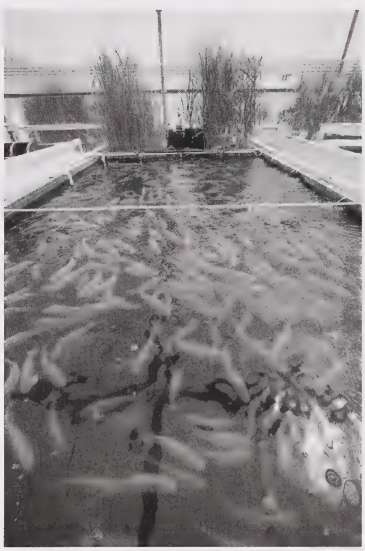
To see how people have affected water quality, read pages 451, 452, and the top of page 453 of the textbook. Study the diagrams carefully.

4. List seven sources of pollution in water systems.

5. What two gases—released by coal-burning industries, metal smelters, and automobiles—cause acid rain?

Compare your responses with those in the Appendix on page 85.

Measuring Water Quality



You may have tested water quality if you own a fish tank, an ornamental pond, or a swimming pool. If so, you know that water quality can be measured directly by chemical analysis. If you live on a farm or acreage and have your own water supply, you know that complete testing of water requires special chemical tests.

There are also simpler ways to determine water quality. You could use a sensitive species as an indirect water-quality monitor (you were introduced to this idea in Grade 7). Using a sensitive species (**bioindicator** species) like frogs can show the health of a certain water system. This species is sensitive to pollution elements. Frog eggs and tadpoles develop in the water and adults spend a great deal of time there. Frogs obtain food from their aqueous habitat. The frog's thin, porous skin allows gas exchanges with the environment, and offers little protection from harmful pollutants.

bioindicator: a sensitive organism that can be used to determine and monitor water quality or the state of other ecosystems

Changes in the health or the number of frogs sends a warning to scientists. What affects the frogs will affect the human population if steps are not taken to correct the problem.

Scientists may also look at the types and populations of organisms present in water bodies to provide another indirect indicator of water quality. Finding E. coli bacteria in the water is a strong indication of contamination. A certain strain of this bacteria can cause severe illness and even death. A recent outbreak happened in Walkerton, Ontario. A litmus test and a test involving coated magnetic beads are two recently developed tests which can indicate the presence of E. coli bacteria.

Turn to pages 453 and 454 of the textbook. Read "Measuring Water Quality."

6. **a.** List two major findings of the Northern River Basins Study.

   b. To balance the good news, write a one-sentence summary of the information provided in Fig. 5.89 on page 454 of the textbook.

7. Turn to pages 455 and 456 of the textbook and read "Organisms in the Water" and "Bioindicator Species." Make a list of organisms that need good quality water and another list of those that can live in poor quality water. The diagram on page 459 of the textbook will help. **Note:** The area showing the midgefly larva and segmented worms should be labelled "Can live in very polluted water."

Note: You may wish to use the Internet or the library to do more research on the water quality of habitats.

8. What are the three most common water-related diseases among people in developing countries?

Compare your responses with those in the Appendix on page 85.

Going Further

You may want to do the following:

- Are you interested in the findings of the Northern River Basins Study? How does the Alberta government respond to water studies? To find out, do the "Internet Connect" on page 454 of the textbook. You might wish to extend your research to include the federal government.

- Would you like to look at bioindicators in a stream near your home? If so, talk to your teacher or home instructor about doing "Inquiry Investigation 5I: Bioindicator Species in the Water." This investigation is on page 457 of the textbook. Be sure to follow the safety precautions!

In the next activity you will use information presented throughout the module and the bioindicator information on pages 453 to 459 of the textbook to form conclusions about the water quality of a stream.

Find Out Activity — Using Bioindicators for Indirect Water Quality Assessment

Carefully examine the average organism counts given in the data table.

Bioindicator Sampling Summary

Organisms	Site A (10 km upstream)	Site B (1 km upstream)	Site C (industrial outlet)	Site D (1 km downstream)	Site E (10 km downstream)
coliform bacteria	2	280	107	73	29
green algae	rare	very abundant	abundant	common	common
leeches	7	3	3	2	5
dragonfly larva	9	0	0	1	3
segmented worms	9	6	8	8	9
snails	6	4	4	3	6

9. Rate the relative water quality (good/fair/poor) at Sites B to E downsteam from Site A. Assume the water quality at Site A is good. Give reasons for your assessments. Base your reasons on the information in the data table.

Compare your responses with those in the Appendix on page 86.

Monitoring and Managing Water

Is water in Canada safe and plentiful? Canada's water is a precious and limited resource. Canadians have been working to manage and use water wisely for many years. Among other factors, as the global human population increases and climate variations threaten more areas of the world, the need for good water management continues to increase.

Turn to pages 460 to 462 of the textbook and read "Monitoring Water Quality" and Water Management."

10. What five water-quality standards have both the provincial and federal governments established?

11. **a.** How much water does the average Canadian use in a day?
b. What sector in Canada uses the most water?

Compare your responses with those in the Appendix on page 86.

Going Further

To find out how water is used in your province, compared to other provinces, follow the "Internet Connect" on page 462 of the textbook.

Compare the water quality of two rivers in Alberta by completing the next activity.

Find Out Activity Changes in Water Quality

Refer to the activity on page 461 of the textbook.

Follow the steps in "Procedure."

12. Complete the questions from "What Did You Find Out?"

Check your answers with your teacher or home instructor.

Going Further

Would you like to know how an expert helps in looking after the Arctic environment?

Read "Ask an Expert" on pages 470 and 471 of the textbook.

Purifying Water

Sparkling fresh water rushes down a mountainside. Is the water safe to drink? Unfortunately, even in these areas, the water may contain harmful substances. There may not be signs warning you about the water, but as a precaution, you should avoid drinking any untreated water.

Having safe water to drink is a world-wide concern. Whether the water supply is a well, lake, or river, the water usually has to be treated to make it safe for human use.

water treatment: the process of purifying water to make it potable

Parasites, suspended or dissolved solids, and pollutants have to be removed or decreased to safe levels. Maintaining **water treatment** facilities is one of the basic services many communities provide their citizens. If you have your own water supply, your family may have to treat the water before drinking it.

effluent: waste water discharged into the environment

Protecting the water supply involves effective treatment of waste or sewage. Purifying **effluent** is costly and may be thought to be unnecessary. Several Canadian communities still dump raw —untreated—sewage into water supplies. Find the map of Canada in the Appendix of this module. You will see the percentage of the population without access to sewage treatment in different regions.

Going Further

Are you interested in water treatment and/or sewage treatment?

- You may get more information on the Internet. Access The Atlas of Canada website at **http://atlas.gc.ca/**. Search terms such as "water treatment in Canada" and "sewage treatment in Canada."
- You might be able to arrange a tour of these facilities in your community.

Read the information and study the illustrations on pages 463 to 465 of the textbook to see how water-treatment technology can be used to produce safe drinking water or clean effluent.

13. Draw a flowchart to show the water purification stages in a water-treatment plant. Your flowchart should show the proper order of the following processes.

- Add chemicals that stick to suspended materials and most bacteria.
- Add chlorine or ozone to kill remaining germs. Possibly add flouride for tooth protection.
- Deliver clean, safe drinking water through underground pipes to homes, businesses, and industries.
- Pumps move the water to the treatment plant.
- Pump water through sand and gravel filter beds. Smaller particles of suspended material are trapped, leaving clear, drinkable water.
- River or lake water enters an intake pipe. Debris and fish are kept out by a screen.
- Suspended solids settle to the bottom of the settling tank.

14. How many times more water does the average Canadian use than the world average?

15. What are three methods used to make salt water potable?

16. How does reverse osmosis differ from osmosis?

Compare your responses with those in the Appendix on page 87.

Going Further

How can you clean water? Design your own water-treatment system by following the instructions in "Problem-Solving Investigation 5J: How to Clean Water" on page 464 of the textbook.

Show your plan to your teacher or home instructor. Once your design has been approved for both safety and for having a reasonable chance of working, you may build your system.

Evaluate your work by using questions 1 to 6 of "Evaluate."

How safe is the trash people throw out? It is estimated that by the year 2005, 3000 tonnes of lead from computer monitors will end up in Canadian sanitary landfills. The mercury from a single fluorescent tube can pollute 30 000 L of water.

What is the possible effect on the water supply from this type of waste? Everyone has a responsibility to keep the water quality as safe as possible.

How can you do your part to conserve water? A five-minute shower with a standard showerhead uses 100 L of water. A low-flow head uses only 35 L. A dripping faucet wastes as much as 35 000 L of water in a year. You can save an average of 10 L of water a year by turning off the tap when you brush your teeth.

Can you and your family, friends, and community contribute to water quality and conservation? Definitely!

Read pages 466 and 468 in the textbook to find out more about what you can do to help the world water situation.

17. Make a list of three things that you can do in your local community to help keep your water clean.

18. Answer questions 1, 2, 6, and 7 of "Topic 6 Review" on page 468 of the textbook.

Check your answers with your teacher or home instructor.

Going Further

Note: This investigation should only be done under the direct supervision of your home instructor or teacher.

Complete a water study by following the directions of "Decision-Making Investigation 5K: Water Awareness" on page 467 of the textbook. Your family and friends could also join you in this activity.

Looking Back

If you were now asked about the water quality of the two lakes described at the start of this lesson, you would most likely ask for more information. There are many factors involved in assessing water quality.

Maintaining the quality and quantity of global water systems is important to all living things.

Section Review

Review the concepts you have studied by answering questions 1 to 4, 6, and 7 of "Wrap-up: Topics 5 and 6" on page 469 of the textbook. **Note:** Think of *water sampling* as one of the key terms. Answers for question 4 are found among the key terms.

Check your answers with your teacher or home instructor.

Conclusion

In this section you have examined the diversity of life found in both freshwater and saltwater systems and the interactions between humans, plants, animals, and aquatic environments. You now know that humans have a significant impact on global water and, therefore, everyone must take responsibility for the management of water quality and quantity. You have also looked at some of the ways water is tested, treated, and managed.

As world populations continue to rise, the pressure on water resources will increase. The quantity of Earth's water is constant. Therefore, it is important that humans understand and protect this important resource.

Turn to Section 3 of Assignment Booklet 5B. Complete questions 9 to 14.

Module Summary

In this module you discovered the importance of water as a resource. Landforms, sediments, and climate interact with water.

You investigated the factors that affect the health and distribution of living things in aquatic systems. There are also factors that affect the quantity and quality of water available for human use. Earth's water system forms one global system and everyone should take some responsibility for maintaining it.

Although there appears to be a more than adequate supply of water, you have seen that the supply of usable, drinkable water is limited. Human activities can put stress on water resources. The future of water resources depends on everyone.

Module Review

To review the module, study the "Unit 5 Review: Unit at a Glance" on page 474 of the textbook.

Turn to the "Unit 5 Review" questions on pages 474 to 477 of the textbook.

1. Answer questions 2, 7, 10, 13, 18, 19, and 21 of "Understanding Key Concepts."
2. Answer questions 28 and 29 of "Developing Skills."
3. Answer question 47 of "Critical Thinking."

Check your answers with your teacher or home instructor.

Turn to Assignment Booklet 5B and do the Final Module Assignment.

SCIENCE 8

APPENDIX

Glossary

abyssal plain: the deep, flat regions of the ocean between the ocean trenches and the ocean ridges

adaptation: a change in structure, form, or habit that increases an organism's chances of surviving and reproducing

algae: an aquatic unicellular organism or a simple, multicellular organism capable of producing its own food through photosynthesis

algal bloom: an explosion in the population of algae (generally due to a large influx of plant nutrients)

Algal blooms are often followed by periods of severe oxygen depletion when the algae die and are decomposed by bacteria.

aquifer: a water-bearing, underground layer of porous rock

The top of the water in the aquifer forms the water table.

arête: a knife-edged ridge carved between two or more cirques or glaciers

bioindicator: a sensitive organism that can be used to determine and monitor water quality or the state of other ecosystems

biomagnification (bioaccumulation): an increase in the concentration of toxins as they move up the levels of a food chain

biosphere: the zones of air, land, and water where life exists

breaker: a wave that collapses in shallow water or on shore

calve: to break away an iceberg from the "parent" glacier

chemosynthesis: a process that some bacteria use to produce food and oxygen from chemicals

cirque: a bowl-shaped basin carved into the side of a mountain by a glacier

clarity: a measure of how clear water is based on the quantity of suspended solids (particulates)

climate: the seasonal patterns of weather conditions at a particular location over several years

contamination: undesirable substances placed in the environment

Continental Divide: a long ridge of mountains in western North America that divides the continent's watersheds into east and west

continental glacier: a glacial ice sheet covering all or a large portion of a continent

continental shelf: a shallow, submerged region of the continent between the coast and the ocean basin

Continental shelves are very rich in sea life.

continental slope: the steep, descending region of the ocean floor between the continental shelf and the abyssal plains

crevasse: a large crack in glacial ice

current: the continuous movement of water in another, larger body of water

DDT: a colourless and odourless water-insoluble insecticide that is toxic to humans and animals

decompose: to break down or decay

deposition: the laying down of eroded materials—sediment

detritus: decaying plant and animal material

dissolved solids: salts, minerals, and organic residues that have been dissolved in water

diversity: variation; differences

drumlin: a teardrop-shaped hill of glacial till formed when an advancing glacier moves over previously deposited moraines

Drumlins point in the direction of the glacier's advance.

effluent: waste water discharged into the environment

erosion: the carrying away of weathered rock or soil materials by water, wind, or ice

esker: a long snake-shaped ridge of sand and gravel deposited under a glacier by a meltwater stream

flood plain: a flat area bordering a river that is naturally subject to flooding; often created by soil deposited during floods

fresh water: water from sources such as lakes, rivers, and rain that is low in salt content

glacier: a large, moving mass of compressed snow and ice found year-round in high-altitude mountains or polar regions

ground water: water that is found beneath Earth's surface in the pores and cavities of rock and soil

hard water: fresh water that contains a large amount of minerals, such as calcium and magnesium

headwaters: the source or upstream areas of a watershed

heat capacity: the measure of how much energy 1 kg of a substance must gain or lose to change its temperature 1°C

horn: a sharp mountain peak carved out by a glacial erosion in three or more surrounding cirques

ice age: any one of the several periods when glaciers covered much of Earth

iceberg: a large chunk of glacial ice floating in the ocean

ice cap: a glacier that flows outward from its centre to cover a large area of land

icefall: a distinctive glacial formation created when glacial ice flows over a steep area and breaks up

icefield: a glacial area that feeds two or more glaciers

impermeable: a barrier that does not allow matter to pass through

lake: generally a large, standing body of water that has deep areas where sunlight cannot reach the bottom

Lakes usually have a stream inlet and outlet that aids water circulation and exchange.

longshore current: water movement that shapes a shoreline through erosion and deposition due to long waves colliding with the shore at a slight angle

marine: having to do with salt water or the oceans

meltwater: run-off from melting snow or ice

millwell: a rounded hole in the ice formed as meltwater streams down through a glacier

moraine: piles of unsorted glacial debris that has been pushed up at the sides, within, or ahead of a glacier

neap tide: the lowest tidal range; created when the Moon and Sun are at right angles to each other in relation to Earth

non-point source: a large area that releases one or more pollutants

ocean ridge: a long, narrow, undersea mountain range created by the sea floor spreading (diverging plates) and/or volcanic activity

ocean trench: a very deep, underwater canyon created by tectonic plates colliding

These plates cause the lighter oceanic plate to bend deeply down under the heavier continental plate.

outflow: water that flows out of a watershed

outwash: rock material deposited by the meltwater of a glacier

pack ice: small sheets of ice formed from freezing seawater

particulate: a small particle of solid or liquid matter

permeable: capable of allowing matter to pass through

phytoplankton: microscopic (usually), photosynthesizing organisms (producers) that drift in fresh water and salt water

plankton: microscopic (usually) organisms that float in fresh water and salt water

point source: a small, defined area that releases one or more pollutants

pond: generally a small, shallow body of standing water

potable: safe or suitable for drinking

river: a larger body of flowing water

run-off: water that flows across the ground instead of soaking in or evaporating

salinity: a measure of the quantity of salts dissolved in water

salt water: water, such as ocean water, that is high in salt content

sea-floor vent: a volcanic opening (in the sea floor) that releases minerals and heat

sediment load: rock material carried in water over a certain time

septic tank: a large, underground container for storing sewage

sewage: solid and liquid wastes generally carried in pipes from domestic, commercial, and industrial areas to sewage treatment or storage facilities

soft water: fresh water that contains few or no dissolved minerals

spring tide: the highest tidal range; occur when the Moon, Earth, and Sun are aligned

stream: a small body of flowing water

streamflow: the measure of speed and volume of water moving in a stream

striations: parallel scratches created as a glacier drags imbedded rocks over bedrock

surface water: water that is found above the ground, for example, in ponds, rivers, and oceans

swell: a long, smooth wave caused by winds and storms far out at sea

tidal range: the difference in height between high and low tides

tide: a twice-daily rise and fall of the ocean surface level caused by the gravitational pull of the Moon and Sun

till: unsorted rock material deposited by a glacier

toxin: a chemical that can cause harm to living things

trade winds: prevailing winds that blow from the east along the equator

These winds push ocean currents toward the west.

U-shaped valley: a valley that has been carved by a glacier into a smooth u-shaped cross section

valley glacier: a river of ice in a mountain valley

water cycle: the circulation of water—powered by the Sun—among the oceans and other bodies of water, the atmosphere, and land

water management: the process of people working to create and/or maintain a safe and adequate water supply

water quality: the degree to which water is suited to various uses based on a variety of characteristics

water quantity: the amount of water available

watershed: the entire area drained by a stream and its tributaries

It's also called a drainage basin.

water table: the level at which all open pores and spaces in the rock and soil are filled with ground water; the top surface of the water in an aquifer

water treatment: the process of purifying water to make it potable

wave: a large ripple set in motion by the wind

In a wave, water particles move up and down to create a pattern that moves along the water's surface. This pattern can move great distances. The water particles remain in place.

weather: atmospheric conditions at a particular time and place

westerly winds: prevailing winds from polar regions that push ocean currents to the east

wetland: a lowland area that is saturated with water, such as a swamp, bog, or marsh

zooplankton: microscopic animals that drift around in salt water and fresh water

Suggested Answers

Section 1: Lesson 1

1. Your body is made up of about 65% water, an apple is 84% water, and a watermelon is composed of about 98% water.

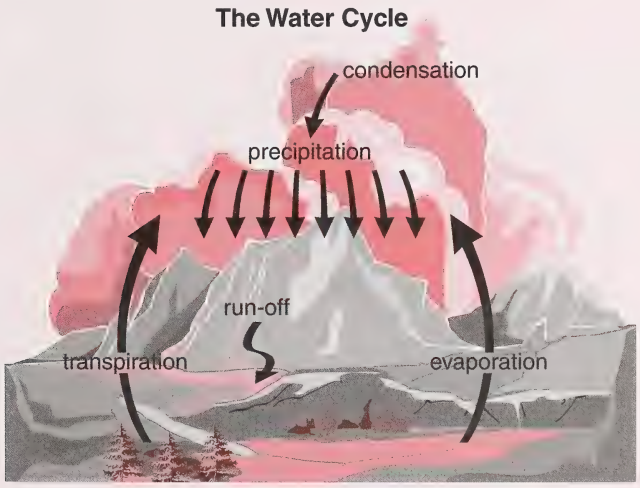
2. On average, a person needs to drink 2.5 L of potable water each day.

3. Answers will vary. Here is one student's estimate:

• one glass of juice in morning	250 mL
• milk with cereal	125 mL
• morning snack drink	250 mL
• soup at lunch	250 mL
• milk at lunch	250 mL
• afternoon snack drink	250 mL
• milk at supper	250 mL
• fruit juice	125 mL
• daily water for "thirst"	250 mL
	2000 mL = 2 L

This amount is less than the average need of 2.5 L.

5. Your diagram should look like the following.



6. It would take about 3000 years for Earth's surface to become completely dry if there were no water cycle.

7. Yes, the water on Earth has been continually recycled. Only very small amounts have been lost in some chemical reactions and life processes.

8. You will likely conclude that there is much more salt water than fresh water on Earth. There is also much more frozen fresh water than liquid fresh water. The amount of fresh water in lakes and rivers is a very tiny percentage of the water on Earth.

9. Surface water is found above the ground, for example, in ponds, rivers, and oceans.

   Ground water is found beneath Earth's surface in the pores and cavities of rock and soil.

10. About 10% of the world's land masses are currently covered by ice. As much as 28% of the world's land masses have been covered by ice in the past.

11. Brazil, Canada, China, and the United States have nearly half of the world's renewable supply of fresh water.

12. **a.** Water management involves balancing the water needs of humans and other organisms with the ability of water systems to maintain a clean and plentiful water supply.

    b. To manage water properly, people need to know the following:

    - the quantity and location of water
    - how water is used
    - the negative effects of overuse and pollution

13. **Textbook questions 1 and 3 of "Topic 1 Review," page 374:**

    1. The water in puddles evaporates into the atmosphere, soaks into the ground, or is absorbed by plants.

    3. Answers will vary. You would have to use less water, plan its use carefully, and may not be able to get enough water to maintain your current lifestyle.

Section 1: Lesson 2

1. **a.** An advancing glacier is getting larger because the snowfall exceeds the snowmelt. The opposite is true of a retreating glacier—it's getting smaller because the snowmelt exeeds the snowfall.

   b. Pack ice is formed from freezing seawater. It is rarely more than 5 m thick and it breaks easily. An iceberg is generally much larger than pack ice and is broken off or calved from a glacier.

   c. A valley glacier forms between mountain ranges. A continental glacier covers a much larger area and is much thicker than a valley glacier; the ice sheet can cover all or much of a continent.

   d. An icefall is falling frozen water that forms when a glacier flows over a steep cliff. A waterfall is falling liquid water.

   e. An icefield feeds two or more glaciers.

2. Your chart may vary, but it should include the following details.

Snow falls.

Weight of new snow increases pressure on snow beneath it.

Snowflakes rearrange themselves into grains.

Grains are compacted into firm mass by weight of snow above.

Meltwater trickles down and refreezes between grains and air is slowly squeezed out of snow mass.

When snow has collected to a depth of 30 m, high pressure turns snow at the bottom into glacial ice.

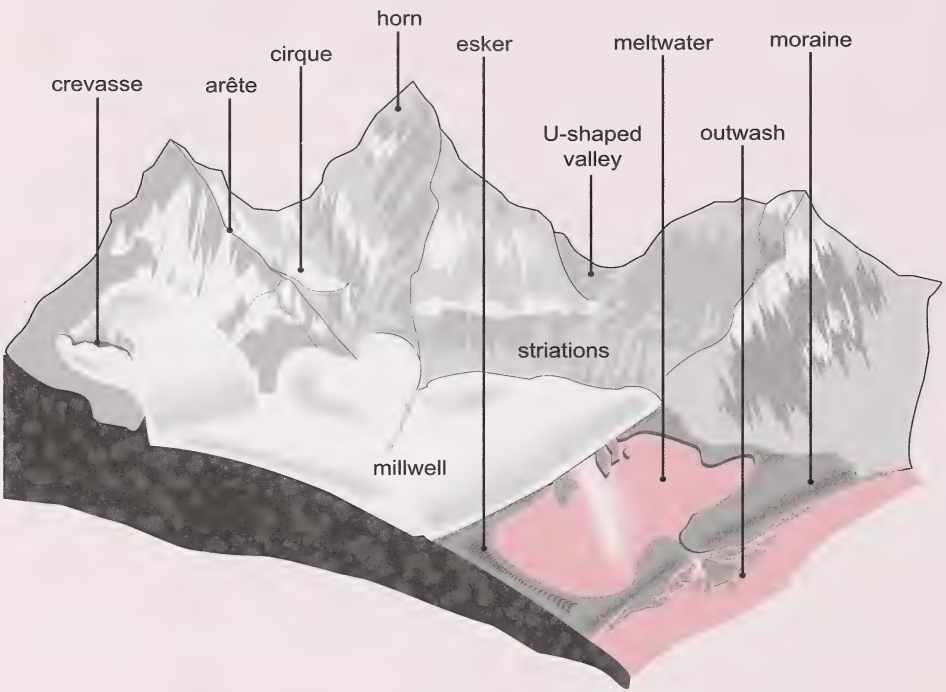
3. Yes. The continental glacier in Antarctica can be called an ice cap. It's a very large glacier that spreads from the centre outward. This spreading is due to forces within the ice body.

4. A glacier is like a river because it flows downhill and it changes shape in response to the terrain. Both a river and a glacier also change the terrain through erosion and deposition.

5. Crevasses and icefalls are unique glacial features.

6. Your diagram should be labelled in the following way.

Glacial Features



7. An erratic is a large, glacially transported rock that is different from the bedrock on which it lies.

8. **Textbook questions 1 and 3 from "Conclude and Apply" and "Analyze," page 383:**

    1. Evidence includes a U-shaped glacial channel that ends at a moraine—a ridge. This is followed by a V-shaped meltwater channel.

    3. Valley glaciers scrape the land and carry rock away. They leave a U-shaped valley marked with striations —grooves—and outlined by moraines—ridges of loose rock.

9. Increased snow and ice coverage causes more sunlight to be reflected back into the atmosphere.

10. a. Climate change hypotheses include the following:

- reduction of *thermal energy* from the Sun
- large volumes of *volcanic* ash blocking the Sun's energy
- mountain-building processes causing an increase in reflective *snow*
- changes in the ocean currents due to *tectonic plate* movement
- changes in the *tilt* of Earth's axis or its *orbit* around the Sun

b. When Mount Pinatubo erupted in 1991, its volcanic ash caused a decrease in atmospheric temperatures.

11. The greenhouse effect is the natural warming of Earth caused by the presence of certain gases in the atmosphere that trap heat from the Sun. With more of these gases in the atmosphere, more heat is trapped than is normal. The unnatural warming due to more of these gases is called global warming.

Section Review

Textbook questions 1, 2, 3, and 5 of "Wrap-up: Topics 1 and 2," page 389:

1. (a) F—Water vapour is water in the *gaseous* state.

(b) F—Most of the world's water is *salt* water.

(c) T

(d) F—Water *management* involves balancing the needs of people, industries, wildlife, and the environment with sustainable water resources.

(e) F—Icebergs are large chunks of ice that break loose from *continental* glaciers.

(f) T

(g) T

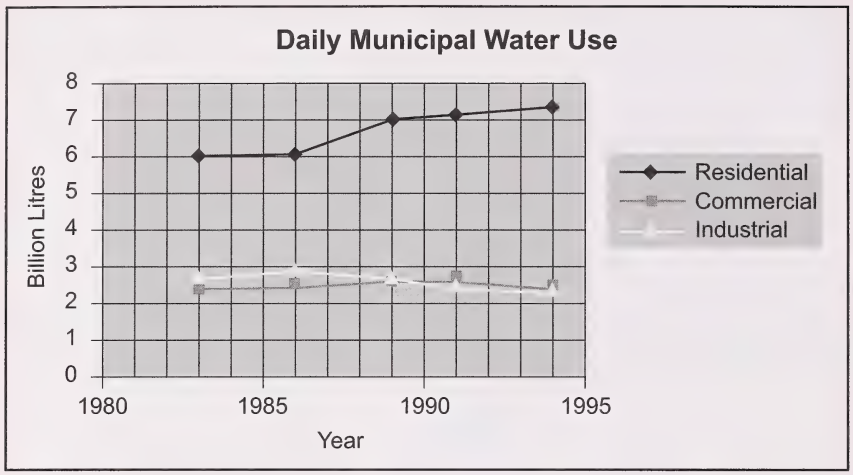
(h) F—The most recent ice age ended about *11 000* years ago.

(i) F—An *increase* in greenhouse gases in the atmosphere may contribute to global warming.

2. Most of the water vapour in the atmosphere evaporates from large bodies of water such as the oceans, seas, and large lakes. A great deal of water vapour is also placed in the atmosphere through transpiration.

3. Answers will vary. One example follows. In decreasing order, four locations where water is found are oceans and seas, ice, ground water, and bodies of fresh water.

5. The student's graph should be similar to the following.



(a.) Answers will vary. They may include the following:

- Residential uses could include cleaning, cooking, and watering gardens.
- Commercial uses could include food preparation, washing equipment, and hot-water heating.
- Industrial uses could include heating or cooling processes, power production, and washing procedures.

(b.) Industrial use experienced a decrease; residential and commercial use both experienced an increase.

(c.) Answers will vary. Sample reasons follow. The increase in residential water usage could be due to more lawn and garden care and more people living in towns and cities. The increase in commercial water use could be due to more people using laundromats and more people eating out. The decrease in industrial water usage could be due to better technology, the wiser use of a costly resource, or fewer factories in operation.

(d.) Answers will vary. For example, people are becoming more aware of water issues. This should mean a decrease in residential use. A further decrease in the other two sectors should also occur. Relevant information can be found on the Internet, from government offices, and in environmental or water-management publications. Newspapers and public-affairs magazines also feature relevant articles.

Section 2: Lesson 1

1. Wetlands are important because of the diversity of plants and animals that live in or around them. They also slow, store, and purify water.

2. The barrier that prevents ground water from soaking deep into the ground is bedrock, which is an impermeable layer of rock.

3. Run-off is water that flows across the ground instead of soaking in or evaporating.

4. a. The Mackenzie River Watershed covers most of northern Alberta.
b. The Saskatchewan-Nelson River Watershed covers most of southern Alberta.

5. Factors affecting the amount of water discharged by a watershed are

- soil conditions
- vegetation
- human settlement patterns

8. Rural areas store more water. Wetlands, forests, and prairies soak up water and are mostly found in rural areas. Water simply runs off building roofs, paved roads, and parking lots, which are all mainly located in urban areas.

9. Factors that determine how a river shapes the landscape are the volume of the water flowing in the river, the speed of the flow, and the timing of the flow. Also, the slope of the land and surface characteristics have an effect.

13. Types of information that streamflow monitoring can provide include the following:

- the amount of water at any particular time
- water quality
- flood and drought predictions
- irrigation and drainage project factors
- the amount and types of sediment carried (sediment load)

14. A higher flow rate gives a river a greater ability to transport more sediments.

15. Sediment monitoring can provide information about

- pollution sources and impacts
- the environmental effects of farming and industrial practices
- deposition rates in navigable waters
- sediment load

19. a. Answers will vary. Positive consequences of building dams include the following:

- storage of irrigation water
- flood control to prevent damage to livestock and property
- municipal water supply
- recreation
- hydro-electricity

b. Answers will vary. Negative consequences of building dams include the following:

- flood-reliant organisms on flood plains harmed by complete flood prevention
- flooding large natural areas or farmland by water behind a dam
- an increase in salts and sometimes poisons left on soil from evaporated irrigation water

Section 2: Lesson 2

1. **a.** About 70% of Earth's surface is covered by oceans.
b. The salt would be 45 m thick, equal to a 15-storey building.

7. Beaches are usually formed during the summertime because wave action is less intense due to calmer weather.

8. Beach erosion can be prevented or decreased by

- building seawalls or breakwaters to slow waves and decrease their force
- building barriers to interrupt longshore currents
- building jetties or groins to control sand movement
- adding gravel to beaches
- putting large rocks into the water beyond the beach to slow waves
- planting vegetation in the water or on the dunes

You may have other ideas.

9. Spring tides are higher than neap tides because the Earth, Moon, and Sun are in line when there are spring tides. This alignment combines their gravitational forces. **Note:** Spring tides are also lower than neap tides. The result is that spring tides have a greater tidal range than neap tides.

10. Increased tidal ranges occur along V-shaped shorelines where the water is forced into a small space.

11. The next low tide on July 2 would be at 8:03 A.M. This is determined by adding 6 hours and 13 minutes to 1:50 A.M. from Table 5.1 of the textbook. **Note:** The time between tides alternates between 6 hours and 13 minutes and 6 hours and 12 minutes.

13. In currents, water moves from one location to another. In waves, water merely moves up and down without moving from one location to another.

14. Trade winds are prevailing winds that blow from the east along the equator. These winds push ocean currents toward the west.

Westerly winds are prevailing winds from polar regions. These winds push ocean currents to the east.

Section 3: Lesson 1

1. The following table shows a comparison between a lake and a pond.

Lake	Pond
larger, deeper body of water than pond	**small, calm, shallow body of water**
water temperature quite constant; surface water usually warmer than deeper water	**water temperature stays the same going from top to bottom; varies with air temperature**
sunlight cannot reach deep parts; rooted plants grow in shallower areas	**sunlight reaches bottom; rooted plants can grow throughout**
generally has inlet and outlet	**no inlet or outlet**
affected by local climate; freezes in cold months but deep waters may not freeze	**affected by local climate; freezes to bottom in cold months**

2. Most marine organisms live in the top 180 m of water because this is the average depth that light can penetrate to. This is where aquatic plants grow. These plants are a food source that attracts other organisms.

3. Answers will vary. Some ways that aquatic animals have adapted to living in moving water include

   - tucking themselves into cracks and crevices
   - burrowing into mud or sand
   - seeking out quieter areas
   - developing special appendages that allow them to hold on to the surfaces

4. Whales and dolphins breathe through a blowhole—or blowholes—on top of their heads. Also, they have developed the ability to exchange about 90% of their lung volume when they surface. **Note:** People exchange only 15% of their lung volume in a single breath.

5. Three adaptations of aquatic animals for filtering food out of water include

   - legs that sweep food into their mouths
   - mouths that have baleen
   - feathery appendages that gather food

6. Specially adapted kidneys allow salmon to tolerate changes in salinity. These specially adapted kidneys allow salmon to move between fresh water and salt water.

7. Some aquatic plants are attached to the bottom of a body of water. Other plants float freely.

8. Some aquatic plants have leaves and flowers on the surface for these reasons:

   - They need to channel oxygen from the air to the plant's roots. This prevents the plants from rotting.
   - Flowers need to be above the water if the plant uses air or insects to transport pollen for reproduction.

9. Seaweed doesn't require roots because it can obtain all the nutrients it requires from the water. An adaptation called a holdfast keeps them in place.

10. Detritus is decaying plant and animal material.

    Algae is an aquatic unicellular organism or a simple, multicellular organism that can produce its own food through photosynthesis.

    To decompose is to break down or decay.

11. Temperature mixing causes water from deep areas to be pushed up by cooler, denser water from the surface. It brings nutrients dissolved from bottom sediments with it.

12. An algal bloom is a sudden, large increase in the algae population. After the algal bloom, the algae die. They are then decomposed by bacteria. The resulting huge populations of bacteria decrease the oxygen content of the water. **Note:** This causes most aquatic organisms in the body of water to die off.

13. Phytoplankton (tiny plant organisms) form the base of many aquatic food chains.

14. If the seal population is reduced, fewer herring are eaten. The herring population will increase.

15. Toxins accumulate in the fat of many animals.

16. Answers will vary somewhat. Here is one possibility:

Note: The direction of the arrows show the direction in which energy and nutrients are transferred. The number of parts shown in brackets is extra information. This information shows how concentration increases along the food chain.

Section 3: Lesson 2

1. Dissolved solids are salts, minerals, and organic residues that have been dissolved in water.

Hard water is fresh water that contains a lot of minerals like calcium and magnesium.

Soft water is fresh water that contains few or no dissolved minerals.

2. Micro-organisms, chemicals, and sediments can get into the water system from plants and animals, soil and rocks, human activity, and from run-off from the land.

4. Your answers may vary somewhat. Sources of water pollution include

- urban run-off
- poorly treated or untreated sewage
- agricultural run-off
- air pollution
- industrial waste
- oil spills
- garbage dumped into the oceans from waste-disposal barges

5. Sulphur dioxide and nitrogen oxides are two gases that combine with water in the atmosphere to produce acid rain.

6. a. Two findings of the Northern River Basins Study are that the levels of some toxins have decreased since the late 1980s, and some substances are carried great distances downstream.

b. Your summary may be worded differently but should reflect the following conclusion:

There are high levels of several pollutants in water, sediments, fish, and other organisms throughout water systems in northern Alberta.

7. Organisms that can only live in good quality water include stonefly larvae, mayfly larvae, dragonfly larvae, beetles, and caddisfly larvae. Organisms that can live in poor quality water include midgefly larvae, leeches, snails, many types of harmful bacteria, various worms, and crayfish.

8. In developing countries, typhoid fever, cholera, and dysentery are the most common diseases caused by organisms in water.

9. Answers may vary somewhat. Sample answers follow.

Water Quality		
Location	**Quality**	**Reason**
Site A	good	**N/A**
Site B	poor	• **coliform bacteria count high** • **very abundant green algae** • **no dragonfly larvae** • **few leeches**
Site C	poor/fair	• **coliform bacteria count fairly high** • **abundant green algae** • **no dragonfly larvae** • **few leeches**
Site D	poor/fair	• **coliform bacteria somewhat high** • **green algae—common (typical) count** • **a dragonfly larvae** • **few leeches**
Site E	fair/good	• **coliform bacteria low** • **green algae—common (typical) count** • **increased number of dragonfly larvae** • **more leeches but still lower than normal**

Note that the data for segmented worms and snails is not very helpful. That's because both segmented worms and snails can live in very polluted water.

10. Provincial and federal water-quality standards have been established for the following:

- drinking water for people
- drinking water for livestock
- protection for organisms living in or near water
- irrigation of crops
- recreation—especially swimming

11. **a.** Each Canadian uses an average of 326 L of water per day.
b. Almost two-thirds of the water used in Canada is for thermal-power generation.

13. This flowchart shows the proper order of processes.

River or lake water enters an intake pipe. Debris and fish are kept out by a screen.

Pumps move the water to the treatment plant.

Add chemicals that stick to suspended materials and most bacteria.

Suspended solids settle to the bottom of the settling tank.

Pump water through sand and gravel filter beds. Smaller particles of suspended material are trapped, leaving clear, drinkable water.

Add chlorine or ozone to kill remaining germs.
Possibly add flouride for tooth protection.

Deliver clean, safe drinking water through underground pipes to homes, businesses, and industries.

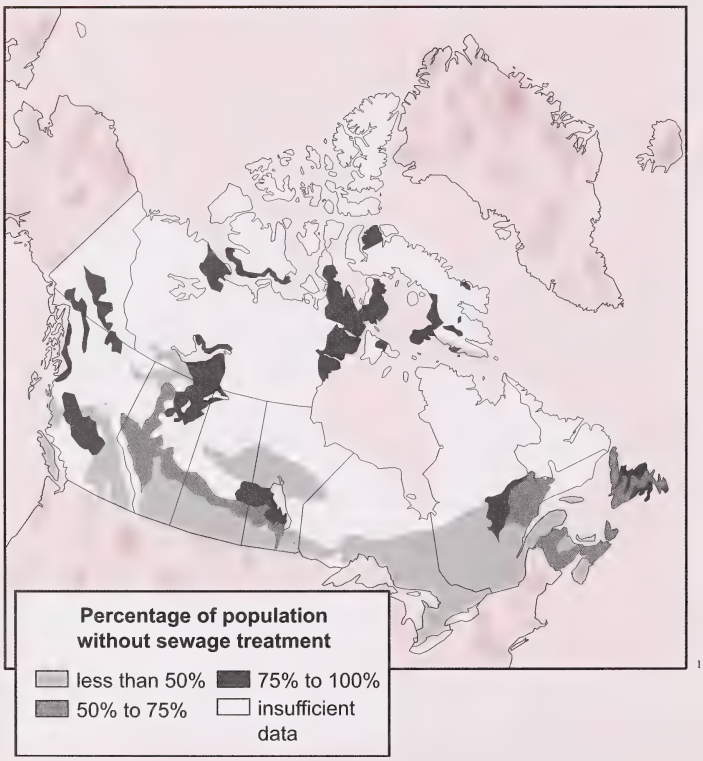
14. The average Canadian uses 100 times more water that the average person in the world does—500 L compared to 5 L per day.

15. Three processes that make salt water potable are evaporation (in desalination plants), distillation, and reverse osmosis.

16. In osmosis, water moves through a permeable membrane from an area of higher water concentration to an area of lower concentration until the two sides are equally concentrated.

In reverse osmosis, water particles are forced—with higher pressure—through a permeable membrane. Energy is used to move the water particles from an area of lower water concentration to an area of higher water concentration. This leaves the solutes behind on the side with lower water concentration.
Note: The potable water is in the area of higher water concentration.

Sewage Treatment in Canada



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